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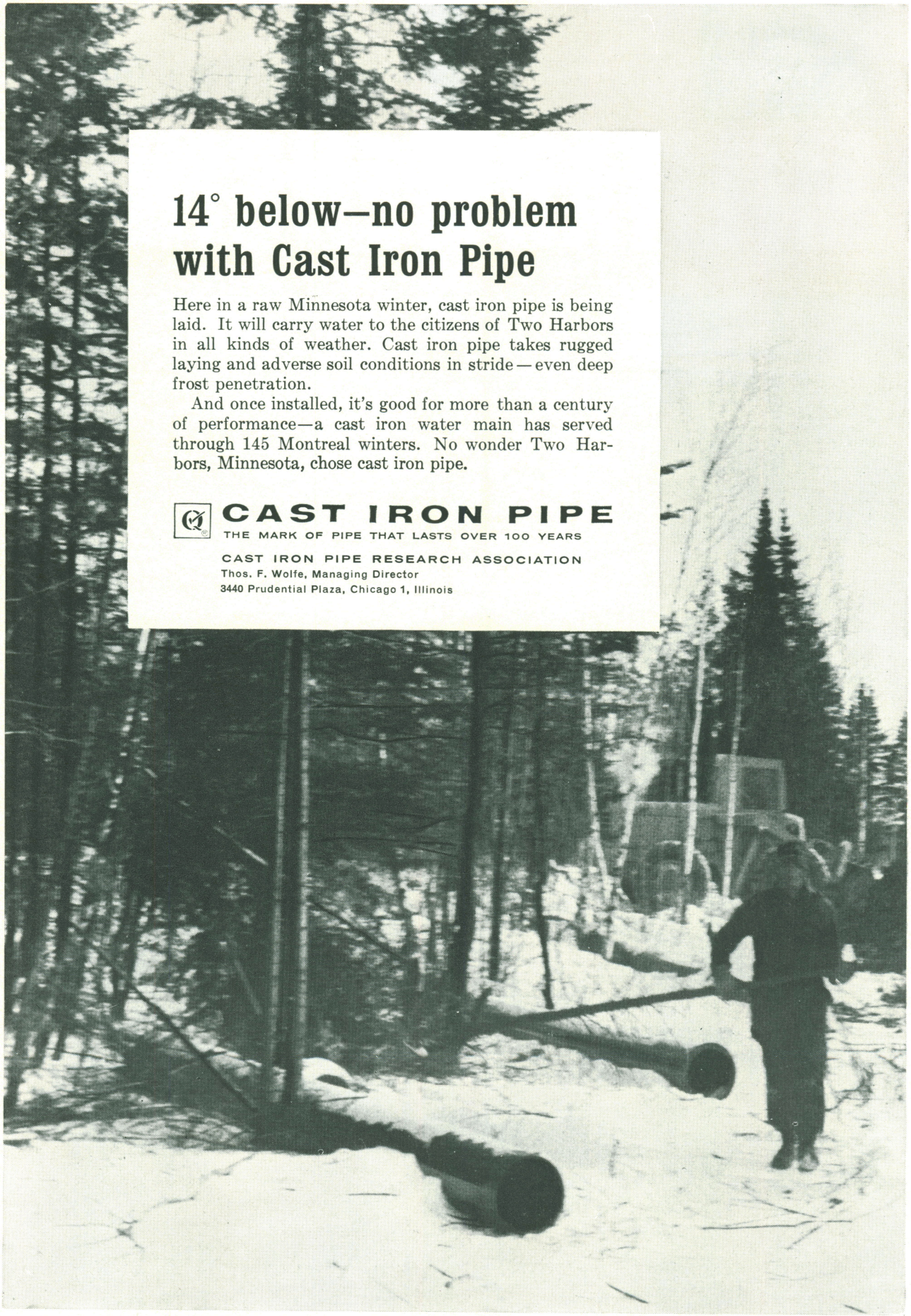

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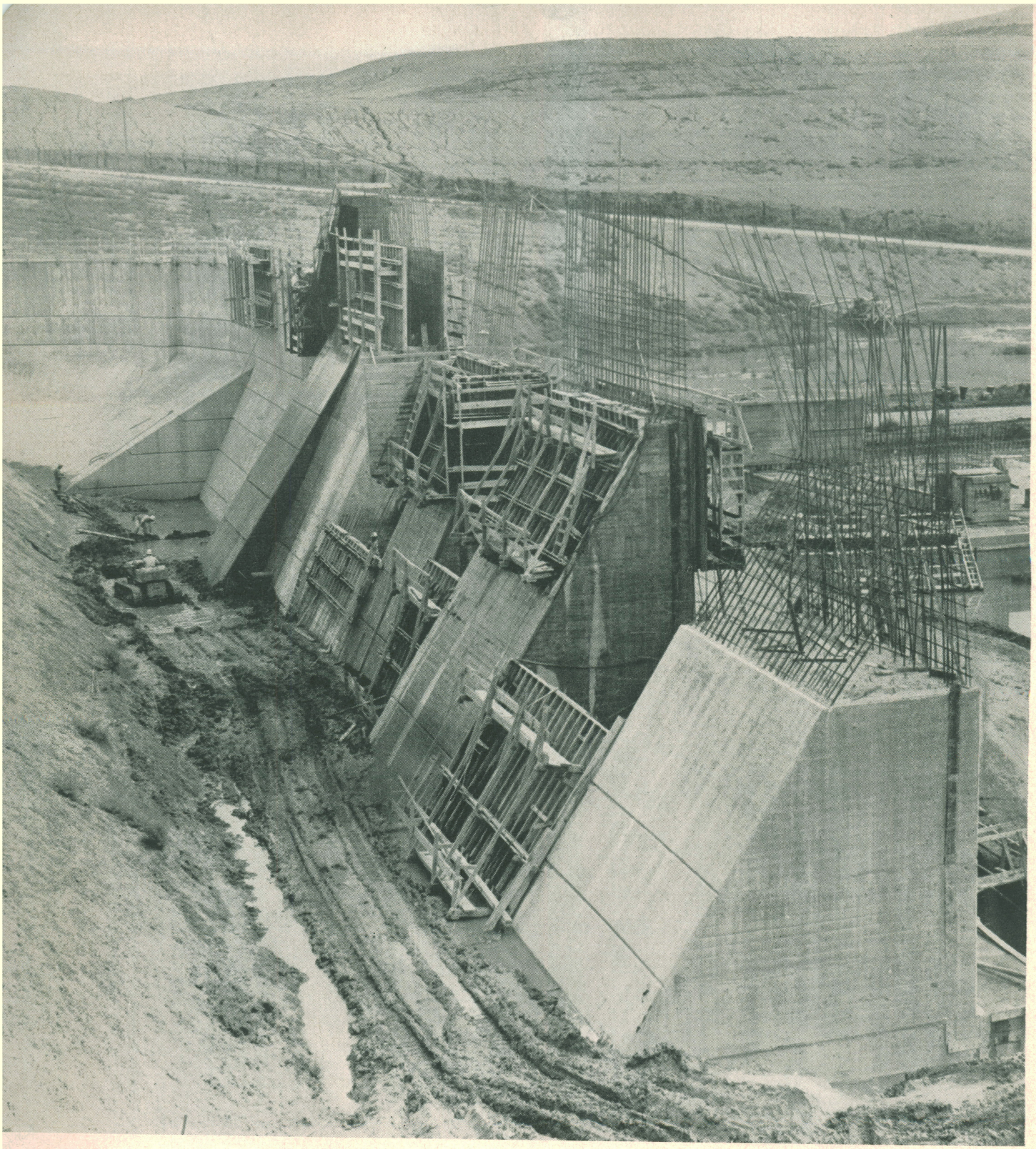
Cover • *All aboard for Biak. This string of LST's, heavily laden with the equipment of invasion, is bound for the action which brought the island into American possession for development as a strategic air base in the Pacific during World War II.*



Massive Monoliths at Oahe

In the stilling-basin wall here shown under construction at Oahe Dam, South Dakota, the stem height of the section in the foreground is 47.5 feet.

The MILITARY ENGINEER

Multipurpose Water Control on the Missouri River

By W. R. SHULER
Brigadier General, United States Army

A VETERAN Montana rancher squinted across the turbulent Missouri River in Northeast Montana one day 32 years ago and shook his head in disbelief. He had just been told by an Army Engineer that an earthen dam 4 miles long was proposed for construction across the river at that location, near Glasgow, Montana. He commented: "They'll never build it; why a thing like that would cost a million dollars."

The Army Engineers, acting on a Presidential Directive, did proceed to construct the project, which is the Fort Peck Dam and Reservoir. The initial cost was $131,000,000. Essentially completed and placed in operation in 1938, Fort Peck had the distinction at that time of being the first major dam across the wide Missouri, and the largest earth-fill structure of its kind in the world. Rising to a height of 250 feet above stream bed, this hydraulic-fill dam is a landmark in the wheat and cattle country of Northeast Montana. The reservoir at full pool extends 189 miles upstream.

Fort Peck was a sort of "guinea pig" for things to come in flood control and water resources development in the 500,000-square-mile Missouri Basin. It was the forerunner of a comprehensive, basin-wide system of storage reservoirs and related works authorized by Congress in the Flood Control Act of 1944. The backbone of this program was reservoir storage, and it made provision for more than a hundred dams on the Missouri and its tributaries.

Today the residents of the basin—ranchers, farmers, city dwellers, and industrialists—take multi-million-dollar dams in stride. They are no longer construction phenomena but are accepted realities in a region that has a long history of destructive floods, droughts, and water famine.

MAIN STEM SYSTEM

Fort Peck is no longer the single major point of control for the use and regulation of the waters of the 2,500-mile-long Missouri, longest river in North America. There are four other Missouri River dams in the Dakotas, with another well advanced in construction. The reservoirs, two of which rival Fort Peck in size and capacity, are part of a growing system of reservoir controls on the main stem and many of its tributaries. Some 35 reservoirs have been completed or are nearing completion by the major constructing Federal Agencies, the Corps and the Bureau of Reclamation.

Newcomers to the water-control scene on the Missouri main stem are the Garrison Dam, which began operation in 1955 above Bismarck, North Dakota; the Fort Randall Dam near Lake Andes, South Dakota, which became operational in 1953; Gavins Point Dam near Yankton, South Dakota, placed in operation in 1957; and Oahe Dam near Pierre, South Dakota, now about 70 percent completed. The sixth in the main stem system is Big Bend Dam near Chamberlain, South Dakota, now well advanced in construction and scheduled for completion in 1966.

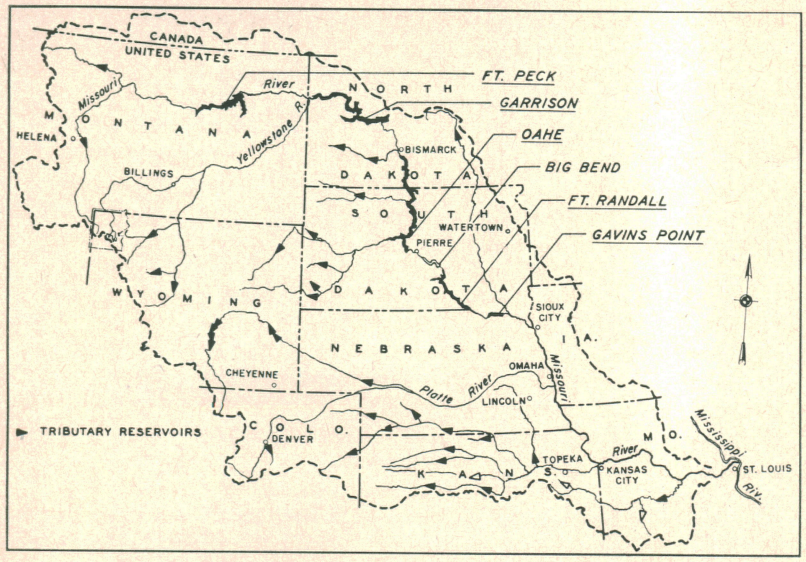
As a single main stem reservoir control project on the Missouri, Fort Peck Reservoir fully lived up to its economic benefit evaluation. In its first twenty years of service engineers estimate it prevented flood damages of over $100,000,000 and provided flow regulation for improvement of downstream navigation, water supply, and stream sanitation. Public recreation and fish and wildlife conservation have become important secondary benefits.

In the beginning Fort Peck presented only a relatively simple operating problem. Originally it had no power installation. Its gross storage capacity of 19,400,000 acre-feet was large, but its authorized purposes were well defined and its over-all control of the Missouri River was necessarily limited by location.

Now Fort Peck is but one unit in a major system of integrated reservoirs having a combined gross storage capacity of about 74,000,000 acre-feet. This is roughly three times the average annual flow of the Missouri at Sioux City, Iowa, a control point below the main stem system. When the Big Bend project is completed, the total storage will be increased another 2,000,000 acre-feet.

All of these projects have, or will have, substantial hydroelectric power installations. Fort Peck now has 165,000 kw of installed capacity; Garrison, 400,000 kw; Oahe will have 595,000 kw when completed in 1964; Fort Randall has 320,000 kw; Big Bend is designed for 468,000 kw; and Gavins Point has a 100,000-kw installation.

Thus, power has become an important factor in the



Missouri Basin Reservoirs, Completed or under Construction

operation of the main stem system, along with three other authorized basic functions of these multiple-purpose projects—flood control, irrigation, and improvement of navigation. They must also serve the interests of water supply, fish and wildlife conservation, public recreation, and stream sanitation.

This complex, multiple-purpose system of impoundments affects, directly or indirectly, the security and prosperity of some 8,000,000 Missouri Basin people and exerts a great influence on the economy and welfare of the nation. As would be expected in a region as large as the Missouri Basin, there are many divergent interests in the control and use of its water resources. Basin precipitation varies widely: in the north and west sections, rainfall measures from 8 to 14 inches annually on the average, which contrasts with 28 to 40 inches in the southeast portion. The economy of the region is still predominantly agricultural. The farmers and ranchers of the low precipitation areas are concerned with water supply for irrigation. In the upper basin there is a very large demand for hydroelectric power. Conversely, in the lower basin interest centers primarily around flood control, navigation, and municipal water supply.

Because of these divergent and sometimes conflicting demands for the use of main stem water storage, the Corps of Engineers, which by law is responsible for operation of the system, is faced with a complicated problem. This is particularly true while the new reservoirs are in the filling process. The problem is magnified by the fact that runoff into the system has been, on the average, 25 percent below normal for the past eight years. In the 1961 season the runoff was estimated to be about 12,000,000 acre-feet, the lowest in many years. This compares with the average of 24,500,000 acre-feet, and a maximum of 36,000,000, recorded in 1927.

At the close of the 1961 navigation season in mid-October, water storage in the five main stem reservoirs totaled 23,700,000 acre-feet, about 40 percent of the requirement to bring them to full operating elevations. Under these adverse interim conditions it has been necessary to ration water to some extent in order to provide the most equitable service to all the authorized functions of the main stem system, and at the same time make prudent provision for continued filling operations.

OPERATION SYSTEM

When the first of the new main stem reservoirs came into operation in 1953, a Reservoir Control Center was established in the Division Engineer Office in Omaha. It was recognized at that time that a central control office would be essential to efficient operation of such a large system of impoundments designed for many services. It was set up as the action instrument of all the Federal Agencies and Missouri River states having an interest in the use of Missouri River water. It is staffed by engineers and scientists. An advisory committee of Federal and state agency representatives known as the Co-ordinating Committee on Missouri River Main Stem Reservoir Operations was created in 1954.

The Reservoir Control Center is the information gatherer and base of activities for this committee. The Center prepares advance estimates of main stem water supply, consolidates advance estimates of water supply requirements, and drafts advance annual operating plans for consideration of the committee. It maintains contact with the individual reservoir managers and with the Bureau of Reclamation power dispatching center in Watertown, South Dakota. The Bureau of Reclamation is the authorized marketing and transmission agency for the hydroelectric power generated at Federal power plants in the Missouri Basin.

The Co-ordinating Committee was established for the specific purpose of giving all interests a forum for expression of their views and recommendations on how the system should be operated year by year. The committee is composed of representatives of the Federal Agencies and states listed:

Federal Agencies: Corps of Engineers, Bureau of Reclamation, Public Health Service, Federal Power Commission, Fish and Wildlife Service, Geological Survey, Weather Bureau, and the Department of Agriculture.

States: Montana, North Dakota, South Dakota, Wyoming, Colorado, Kansas, Missouri, Iowa, Nebraska, and Minnesota.

The state members are designated by the respective state governors. The committee holds periodic meetings, usually twice yearly in April and September, special interim meetings as required, and maintains frequent contacts with the Reservoir Control Center.

In September the committee reviews the proposed operating plan for the year ahead as drafted by the Reservoir Control Center, and then recommends an annual operating plan. In every instance the Corps of Engineers, as the responsible agency, has adopted the plan agreed upon by the committee. The Reservoir Control Center executes the details of operation by preparing and issuing daily schedules of water releases and power generation rates for each of the main stem projects.

At the Reservoir Control Center a tremendous volume of data is compiled and maintained on weather conditions and outlook, water runoff, operating criteria under varying runoff conditions, flood develop-

ments, hydroelectric power generation, releases of water for navigation, and other information. In addition to conventional engineering and computer equipment, the Reservoir Control Center has special basin-wide plotting maps, reservoir storage and river discharge control charts, weather teletype and facsimile weather maps and equipment, and special direct-wire teletype and radio communications with various projects. Modern, high-speed electronic computers and automatic plotters are used.

The working staff is divided into two main groups: a Reservoir Regulation Section and a Power Production Unit. Each group maintains continuous contact with the related activities at the projects, the Corps of Engineers District offices, the Bureau of Reclamation power dispatching office, the Weather Bureau, Geological Survey offices, and state officials.

BALANCE OF INTERESTS

The serious water runoff deficiencies in the upper Missouri Basin in recent years have made it impossible to satisfy all the desires of the various interests in main stem water use. The annual operating plans have had to be tailored to fit the available supply.

Customers for Federal hydroelectric power in the Missouri Basin would like reservoir storage increased in the summer to raise the head for increased power production at the main stem power plants. They would like to have winter power releases increased because the peak firm demand in the area served occurs in the winter season. But this could be accomplished under present water-supply conditions only at the expense of shortening the navigation season.

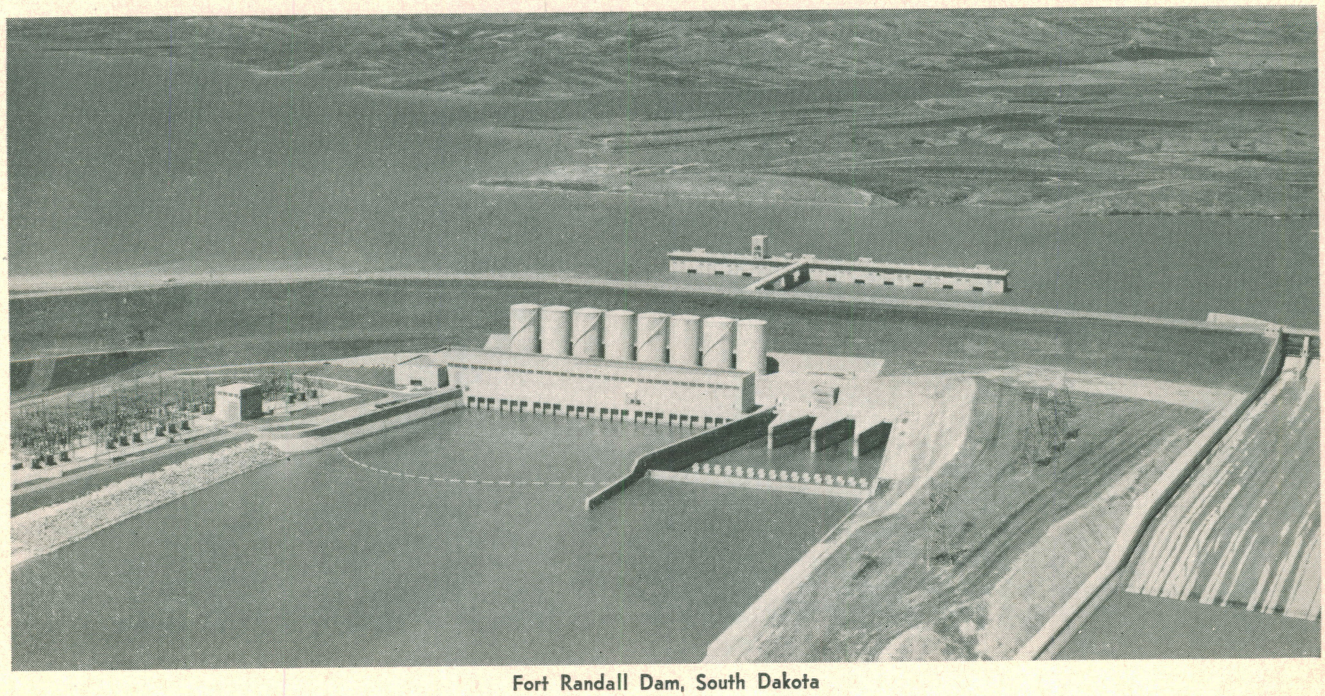
Lower basin navigation interests naturally seek longer navigation seasons, which could be provided only by longer releases of water from the reservoirs. Navigation operates on an open-river plan on the lower Missouri, which is not controlled by systems of locks and dams as on the Ohio, upper Mississippi, and Illinois Rivers. Navigable depths on the Missouri below Omaha, Nebraska, are provided by reservoir releases, supplemented by channel improvements and bank stabilization works. Releases of reservoir water during navigation seasons range from about 15,000 to 30,000 cfs. Winter season releases average about 8,000 to 9,000 cfs.

Thus, the Corps of Engineers and the advisory Co-ordinating Committee have been faced with the problem of providing a delicate balance of water use as against water supply. Even under these handicaps the main system has been able to provide about 85 percent of full service to both power and navigation. In 1961, the four operating power plants produced 3.8 billion kwh of hydroelectric power. Despite shortened navigation seasons, the movement of bulk commerce by towboat and barge on the lower Missouri has grown. Commercial tonnage moved on the river in 1961 was 1,575,000 tons, an increase over the previous year.

For flood control, ample storage capacity is available to catch far more water than the flood of record on the upper Missouri. When the system is completed and the individual projects filled to operating levels, empty reservoir storage of about 16,000,000 acre-feet will be maintained to catch flood flows. The record upper basin flood of March-April 1952 on the Missouri had a total runoff of 15,000,000 acre-feet.

Provision has also been made for future irrigation requirements of the Bureau of Reclamation from the Garrison and Oahe Reservoirs. This includes the Garrison Diversion Project in North Dakota, and a diversion from Oahe which would provide irrigation water in South Dakota.

It is apparent that the complex job of system operation will require continued skillful handling and a high degree of co-ordination. The available water supply, as indicated in a water adequacy study and report by the Missouri Basin Inter-Agency Committee, will be sufficient to meet the authorized purposes well into the next century, once the filling process is completed. A few wet years, or even a succession of average runoff years, would fill the system rapidly and automatically eliminate some of the present problems and restrictions on operating the system.



Fort Randall Dam, South Dakota

13. Cave Warfare on Biak

By KENNETH J. DEACON

THE struggle for Biak in the summer of 1944 was between men in the open and men in fortified caves. It was an operation in which American combat, amphibian, and aviation engineers fought with distinction.

Biak, a triangular island north of Geelvink Bay, New Guinea, measures roughly 25 by 50 miles. It is mostly coral and limestone, covered with brush in the north and jungle in the south. Only the southeastern coast had strategic importance during World War II. There the Japanese were developing the most extensive airdrome facilities in the 900-mile stretch between Hollandia and Halmahera.

The terrain of this area had a vital influence on tactical operations. Behind a narrow strip of coast, densely-wooded ridges rise several hundred feet and drop to an inland plateau. Within the ridges are many caves, concealed by vegetation and connected by tunnels and crevices. The ridges begin about 3 miles east of Bosnek and extend westerly, nearly touching the water at Parai. A mile west of Mokmer they swing inland and then westward before again veering toward the sea. In this open area were the airdromes which made Biak a prize worth fighting for.

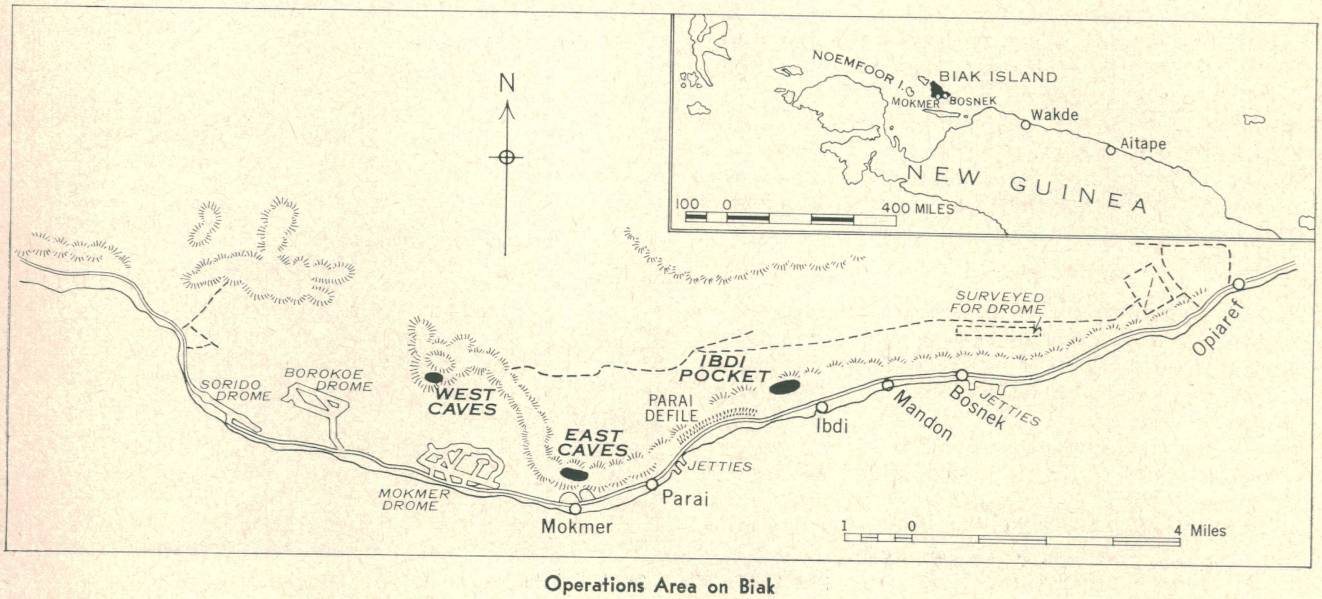
Over 11,000 Japanese were clustered in several fortified places which overlooked the southeastern coast. The most westerly of these, known as the West Caves or Sump area, was on a coral terrace about 1,200 yards north of Mokmer Drome. This position commanded observation and fire over the airfields on the plain. Above the village of Mokmer was the East Caves or Mokmer Pocket area, from which the defenders could control movement along the coastal trail toward the airfields. Overlooking the coast farther to the east was a third major defensive position, the Ibdi Pocket. The base of the cliffs nearly met the sea at the Parai defile between the Mokmer and Ibdi Pockets. Because of this bottleneck, a handful of men could impede the movement of a much larger force. Engineers participated in bitter fighting to reduce these strong points.

THE BOSNEK CAVES

On May 27, 1944, Hurricane Task Force (essentially the 41st Infantry Division, reinforced) made an assault landing at Bosnek. Within a few hours the task force extended its beachhead a mile to the east and west and dispatched patrols northward against slight resistance. While on reconnaissance a small infantry patrol perceived two suspicious-looking caves in the ridges directly behind the center of the beachhead. As the patrol leader went forward to investigate, he was mortally wounded. Hostile fire from the caves prevented his men from reaching him.

Just at that time Capt. Don D. DeFord and 1st Lt. Byron A. Brim, of Company E, 542d Engineer Boat and Shore Regiment, appeared on the scene. They were selecting a route for an interior dump road. Their unit, part of the shore party, was unloading cargo, building exit roads, and setting up supply dumps for the task force.

Realizing that these Japanese caves menaced all beachhead operations, Captain DeFord called for volunteers to form an assault party. After selecting an additional officer and seven enlisted men from his company and the 2d Engineer Special Brigade Support



Operations Area on Biak

Main Entrance of West Cave

Battery, he assigned them to positions for the attack. At the rear two men with borrowed bazookas covered both targets. Several men with carbines moved ahead and provided protective fire as DeFord and one man closed in and hurled grenades into the cave at the right. When DeFord summoned the occupants to surrender, a Japanese officer dashed out and charged at him with drawn saber. Five shots felled the assailant within 6 feet of the captain. Two more Japanese with bared bayonets lunged toward him. Again split-second marksmanship dropped the leading Japanese in his tracks, while the other, wounded, fled into the cave. In the skirmish one engineer soldier was wounded.

Lieutenant Brim and two soldiers (one an infantryman from the original patrol) pursued the Japanese into the cave. They penetrated about 15 feet, and in an exchange of shots the infantryman was wounded and his assailant killed. The two engineers moved the wounded man to a safer place, and the assault party then neutralized the cave with bazooka and tommy-gun fire.

Meanwhile voices were heard from the other cave. Several rockets were fired into it and, as before, the men advanced under cover of small-arms fire. After blasting the entranceways with bazooka rockets and grenades, the assault party withdrew for the night.

The next morning DeFord returned to investigate the results. The number of dead was appalling. He found plenty of unused weapons and ammunition as well as maps, diaries, and records of value to the task force G-2. The engineers sealed the erstwhile strongholds to make sure that they would never again menace the beachhead.

CAPTURE OF THE AIRDROMES

On D-Day, the 162d Infantry began to advance along the coast toward the airdromes. Exposed to direct aimed fire from the higher ground, the troops took a lot of punishment without gaining their objective. As the task force commander was under relentless pressure to secure the airfields at the earliest possible time, he decided to use the 186th Infantry in a sweeping maneuver over the plateau behind the enemy's main defenses. This regiment moved 4 miles east of Bosnek and then followed a trail up to the plateau. Despite harassment from the enemy and a tenuous supply line, the 186th crossed the plateau and on June 7 pushed into the airdrome area and onto the beach.

Just as the troops seized their objective, hostile artillery which they had bypassed began to bombard the area. Since the Japanese could obstruct the overland supply trails, the regiment had to depend on resupply runs by amphibian engineers and their landing craft. On June 10, engineer boatmen ferried Company A of the 863d Engineer Aviation Battalion to the new beachhead to reconstruct the airdromes to American specifications. Hostile fire was so intense that construction parties could complete only the most urgently needed operations, which included the preparation of a strip for fighter aircraft. During the first week they collected 3 tons of shell fragments from this strip. The drome area was the hottest spot on the island, where neither aircraft nor construction equipment could venture without inviting destruction.

THE WEST CAVES

The West Caves were three large depressions or sumps connected by underground tunnels and caverns. Numerous fortified secondary caves, bunkers, and foxholes guarded the approaches. The sumps could house over 900 men and hold enough supplies for them to withstand a long siege. Underground water was available. Rooms adjoining the sumps had wooden floors and electric lights.

After determining the location and extent of the enemy's fortifications, the 162d and 186th Infantry Regiments launched co-ordinated attacks against the West Caves area on June 19. The next day, covered by rifle and automatic weapons fire, engineer and infantry flame-thrower patrols sprayed numerous defensive positions leading to the main caves. On June 21, the 1st Battalion, 162d Infantry, supported by two tanks, reached the entrances to the westernmost sump. The assault troops countered hostile fire with that of flame throwers, grenades, and tank guns. These weapons were not altogether successful, because stalagmites and stalactites shielded the winding entranceways.

Then a detachment from the 116th Engineer Combat Battalion (41st Division) poured five drums of gasoline through crevices on top of the cave. Ignited, the fuel produced deadly results which destroyed the enemy's will to resist. According to a prisoner of war, the Japanese commander held a solemn ceremony in

Bulldozer Burying a Japanese Naval Gun

Engineers at Entrance to East Caves

the main sump during the night of June 21-22. He ordered those who were able-bodied to try to escape to the north in any way possible. He distributed hand grenades to the sick and wounded that they might kill themselves to avoid capture. After burning the regimental colors he took his own life.

That night many Japanese made desperate attempts to break out of the caves. Others, who had been firing on the airdromes, were intercepted before they could get back. On the morning of the 22nd, infantry troops, under cover of tank and machine-gun fire, returned to the sump. From within resounded a series of explosions probably caused by burning gasoline as it reached ammunition stores. Returning that day to seal the caves, combat engineers encountered some fire from the entrances. After setting off several 25- and 50-pound charges, the engineers tamped three large drums with gelignite and inserted primers at both ends. They hauled these massive charges forward on trailers, lowered them by winch cables, and fired them electrically, thus ending all resistance in the main caves. The smaller ones were reduced by a combination of tank fire, explosives, and flame throwers.

The battle for the West Caves was the climax of the Biak operation. No longer could the Japanese threaten the airfields, which were then developed into mighty bomber bases.

THE EAST CAVES

The East Caves consisted primarily of two large sumps near the top of the ridge behind Mokmer Village. One of the sumps had an opening that faced the sea. There, and in nearby caves and crevices, the Japanese set up mortars, antiaircraft guns, and machine guns. The slope of the ridge to the rear was studded with pillboxes. From two observation posts the defenders could view everything along the coast between Parai Jetty and Mokmer Drome. Earlier, from these fortified heights, the Japanese had held up the advance of the 162d Infantry along the coast. They had also subjected supply convoys and engineer road builders to constant harassment.

Now, having reduced the West Caves, the task force turned its attention to the East Caves. Following bombardment by artillery, mortars, and naval guns, the Japanese began to evacuate the area.

On June 28 Company E, 542d Engineer Boat and Shore Regiment, opened a coral pit below the caves. The men, particularly bulldozer and shovel operators, came intermittently under fire. Captain DeFord, the company commander, mounted .50 cal and 37mm guns around the perimeter and sent out patrols to protect the working parties. As these measures drained the company's productive capacity, he ordered the patrols to take decisive offensive action. July 2, supported by tanks, they attacked the forward part of the caves with bazookas and grenades and sealed other sections with dynamite. They inflicted casualties and captured a number of rifles, sabers, and light machine guns. Dive bombers meanwhile demolished the bunker area behind the caves, and on the following day Company E, 163d Infantry, occupied the ground above them. On the next two days, volunteers from Company C, 116th Engineers, descended into the sumps with demolitions and assault weapons. They shot several of the enemy and killed an unknown number by fire and explosions. They also destroyed large quantities of food, ammunition, and other supplies, including guns and mortars. When they were finished, few if any Japanese remained to cause further trouble.

THE IBDI POCKET

The third strong point, Ibdi Pocket, was on the main coastal ridge between Ibdi and the Parai Defile. The terrain was a series of sharp east-west ridges, separated by deep crevices, and connected in places by cross ridges. The pocket formed a rectangle about 400 by 600 yards, covered with dense jungle. It contained a score of fortified caves, which served as defensive positions, living quarters, and supply installations; about 75 log and coral pillboxes; and many trenches. Armed with machine guns, mortars, and artillery, the thousand or so Japanese who occupied this area constantly harassed military movements along the coast.

The 41st Division began early in July to clear the area. This task proved extremely arduous and discouraging because the terrain and vegetation inhibited movement and observation. Following heavy aerial and ground bombardment and direct assaults with flame throwers and bazookas, resistance was finally broken by July 22. In the mopping-up operations, which lasted four days, engineer demolitionists sealed caves and destroyed pillboxes and bunkers.

CONCLUSIONS

For all practical purposes, Hurricane Task Force had accomplished its primary tactical mission. Its combat experiences on Biak pointed out the limitations of caves and other systems of static defense. The caves were psychologically dangerous in that they encouraged a false sense of security and dulled the offensive spirit among their occupants. Fighting in the open, the Americans exercised the initiative at all times. For every American who lost his life on Biak, 14 of the enemy perished. By holing up in caves, the Japanese became dispersed and immobilized. Their commander was unable to shift large concentrations to any point where they might have annihilated the smaller but mobile attacking units. For all their resources in men and firepower, the Japanese were unable to win a single decisive engagement. At best they could only postpone the hour of defeat.

Placing Piles by Vibrations

By ANTHONY V. IARROBINO

PILE DRIVING is one of the world's oldest construction practices, yet up to the present time, although there have been refinements in techniques, there has been little change in method since prehistoric man hammered wooden piles into the earth as foundations for his huts. The current method of placing piles is still by impact although it is applied by mechanical devices. Now an entirely new method employing vibrations has been developed and equipment has become available for pile placement by this means.[1]

PRINCIPLE AND DEVELOPMENT

The principle that devices powered by sonic waves expand and contract in relation to the frequency of vibration is employed by the sonic driver to large masses utilizing high power. The driver working at up to 140 impulses per second sets up vibration waves travelling at the speed of sound in the material that the pile is composed of, the frequency being such as to place the pile in resonance frequency so that energy is transferred with high efficiency from the driver to the base of the pile. This power, coupled with the expansion and contraction of the pile, plus the dead weight resting on the driver, forces the pile smoothly into the earth. This method is likened to the sonic method used for drilling or piercing metals, whereby it is possible to drill or pierce hard metal with a softer tool. Thus, the sonic driver vibrates piles into the ground whereas conventional methods place piles by mechanical impact.

The first public demonstration of this device was held on October 26, 1961. The sonic driver demonstrated is a prototype which has been in operation for several months. It develops 400 hp at the driving head and, since the pile is reportedly resonating at its natural vibrating frequency, virtually all the energy is transmitted as driving energy at the tip.

The demonstration consisted of driving two 71-foot closed end 12¾-inch outside-diameter pipe piles within 15 feet of each other, one being driven with a mechanical driver and the other with the sonic driver. The sonic driver was welded to the top of the pile permitting extraction and re-use of the pipe. On the pipe, and separated by air springs, rested 5 tons of dead weight referred to as "bias weight." Outboard of, and attached to the leads and driver was a platform upon which rested a Sherman Tank gasoline engine capable of delivering 400 hp to the sonic driver. This platform with the operator moved in the same direction and through the same vertical distance as the driver. Throughout the entire driving operation a taut cable was maintained on the driver by the crane operator.

The log of the boring, taken within 10 feet of the driving, was obtained by using 2½-inch inside-diameter casing driven with a 300-pound hammer dropping 24 inches, and sampling performed with a 1⅜-inch inside-diameter split spoon using a 140-pound hammer dropping 30 inches. The upper 10 feet consisted of miscellaneous loose coarse fill underlain by 5 feet of soft, moist, organic silt underlain to a depth of 77 feet with a moist, silty sand in a medium to dense state of compaction.

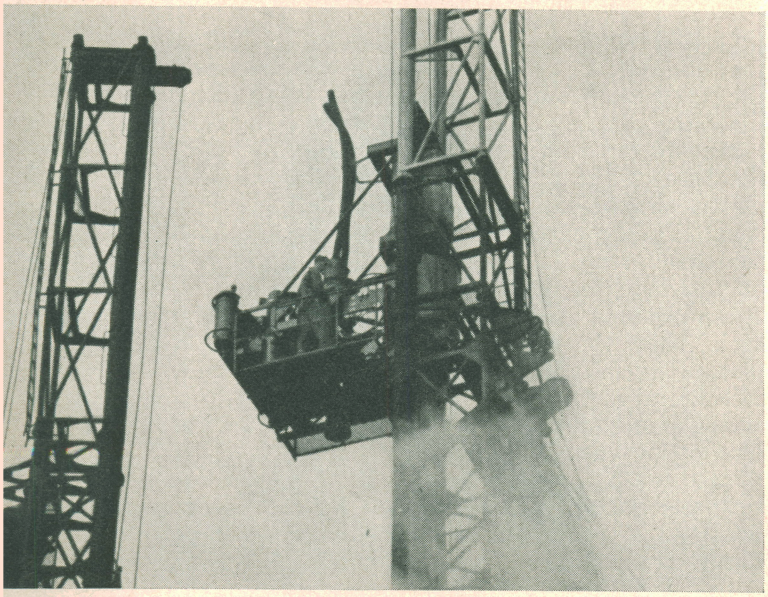
The two piles were driven simultaneously. Within 105 seconds, the sonic pile had been driven 65 feet and extracted 65 feet whereas the pile being driven by conventional means had penetrated 22 feet. As driving with the hammer continued, the sonic pile was relocated and again driven and extracted 65 feet as the other pile progressed from 29 feet to 31 feet. This was repeated four more times, the sonic being driven each time 65 feet in an average time of 60 seconds and extracted each time 65 feet in an average time of 70 seconds. During the period required to drive the pile by sonic means six times to a depth of 65 feet and to extract it each time, the pile driven by the conventional means operating at approximately 50-55 blows per minute penetrated to a total depth of 47 feet.

RESULTS AND EVALUATION

The results from the demonstration were spectacular for it was apparent that the pile driven with the conventional type hammer had met refusal and would never reach a depth of 65 feet under these driving conditions. However, for a realistic comparison be-

[1]The Bodine Sonic Pile Driver, invented and patented by A. G. Bodine, Jr., a physicist, probably as an outgrowth of a previous invention of his of a similar nature used for extracting oil well casing. C. L. Guild Construction Co., Inc., of East Providence, R. I., has the exclusive world rights to this patent relative to pile driving.

Rigs for Demonstration of Pile Driving by Conventional Hammer, left, Compared to Sonic Driver, right



The Sonic Driver, Bias Weight, Power Plant, and Operator during Test

tween these methods, it should be emphasized that, if the test conditions were actual project conditions, a contractor would use a high-energy conventional hammer capable of delivering blows with high rapidity rather than the model used in the test, which obviously was too light to do the required job.[2] Under such conditions, the comparison between the methods would not be as dramatic as that demonstrated. To interpret and forecast results, it must be understood that the effect of vibration is to reduce the internal friction of the soil and the skin friction on the pile, and that acceleration is the main vibrator parameter influencing these values. The driver used in the demonstration reportedly can develop the desired accelerations. Consequently, it should be most effective in non-cohesive or slightly cohesive material such as sands or gravels; whereas, driving pipe piles capped with flat steel plates through a medium to dense granular material is one of the most difficult conditions for conventional driving.

Although the test conditions were such, relative to pile type, soil condition and type, and weight of conventional hammer, as to favor the sonic driver, the demonstration was impressive, showing the sonic driver to be an effective, practical, and economical method for placing pipe piles in sands with a minimum of noise and shock. The effectiveness of this technique in placing closed-end pipe piles in other soils or in placing other pile types under varying soil conditions has yet to be demonstrated publicly.

In soils such as clays, where cohesive and adhesive forces are present, the major factor for successful placement is the amplitude of vibration (at constant acceleration). Whether or not amplitudes of large enough magnitude can be developed for deep driving in highly plastic soils has yet to be proven. Successful placing and extracting of H piles approximately 100 feet in length in plastic materials similar to the Boston blue clay have been reported.

The type and material of the pile are other important considerations in evaluating potential uses of this method. It is reported that timber and precast concrete piles can be successfully driven without damage to them by overstressing. For non-mandrel type piles, soil conditions as well as allowable pile fiber stress should impose the limiting condition upon the effectiveness of this method. Because of the flexibility of the connections in mandrels of tapered piles currently being used (with the ensuing loss in transfer of energy), the sonic driver is not applicable to these types. However, the Cobi mandrel type pile of uniform cross section reportedly can be successfully driven by this method.

[2]Vulcan Model No. 1 Hammer.

APPLICABILITY

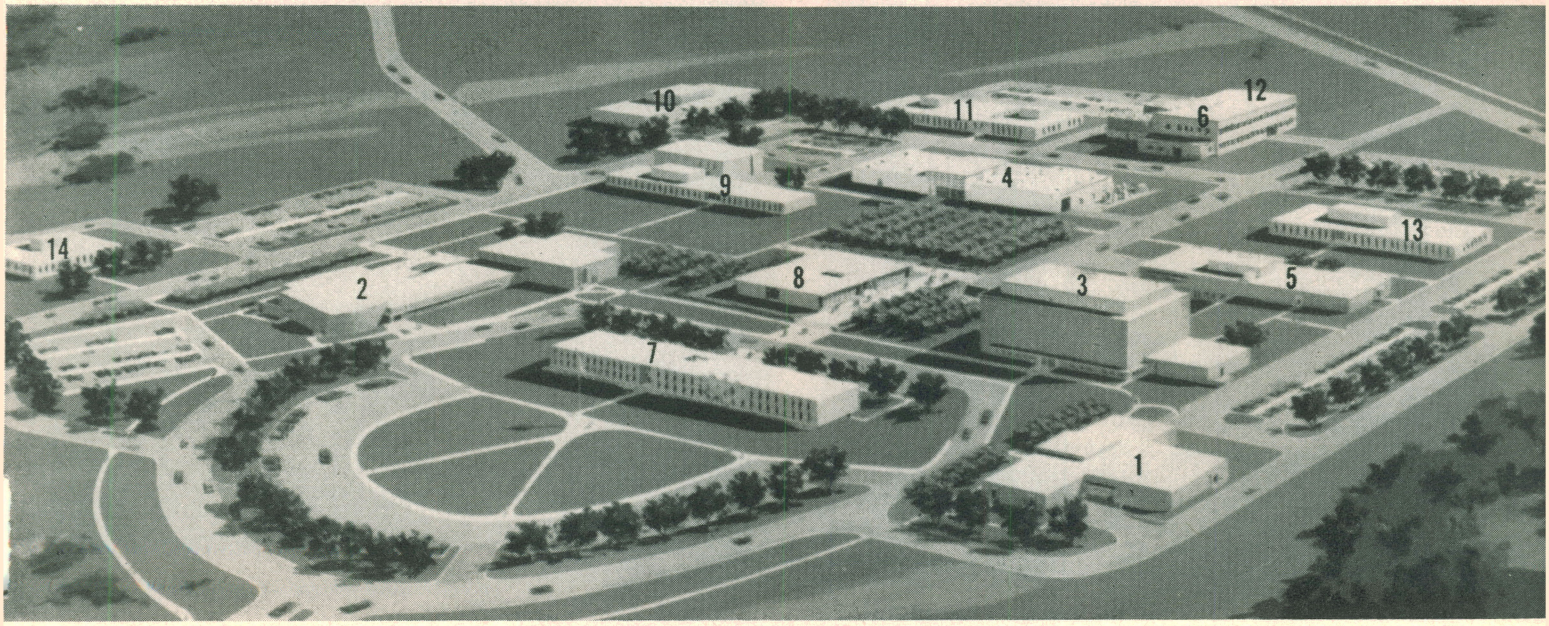
It appears that the greatest and immediate applicability of the sonic driver is in the placing of non-mandrel, end-bearing piles and piles of predetermined length. It seems to be well suited to the placing of sheet piling and ideally suited to their extraction which frequently poses construction difficulties and delays.

Evaluation of the applicability to the placing of friction piles will have to be deferred until some acceptable method is devised for evaluating carrying capacity of such piles and the effect such vibrations have upon the properties of the soils involved. A formula similar in nature to the one used by engineers for determining bearing for piles placed by impact, expressing relationships between carrying capacity, frequency and amplitude of vibration, pile deflection, and penetration is currently being formulated. Such a formula will require numerous field loading tests on various types of piles placed under varying soil conditions. The sonic driver may solve the difficulties encountered when attempting to drive long piles to bedrock or hardpan through plastic material. This vibratory method is expected to keep the pile in motion preventing its "freezing in" before the desired tip elevation is reached. The sonic driver operates with an almost total lack of noise and outside vibration, permitting use in underpinning, and in heavily built up residential or commercial areas, where noise or potential damage to adjacent structures would otherwise present a problem.

Pile placement by the vibratory method may have particular significance and applicability to placing piling in permafrost. Currently, piles in permafrost are placed either by steaming or preboring.[3] Apart from economic considerations, the greatest disadvantage of these methods is the elapsed time required between piling and superstructure construction necessitated by backfreezing of the slurry necessary to backfill the over-sized holes resulting from these methods. Steaming methods introduce uncertainty as to the structural integrity of the permafrost on account of the large amount of heat introduced. The applicability of vibratory placement in permafrost has yet to be shown, however. Its feasibility can only be proven by field demonstration. If successful, it would eliminate the need for steaming, preboring, and slurrying with their disadvantages of relative cost, time, and uncertainty.

The development of the sonic driver is probably the most outstanding improvement in the field of pile driving since the introduction of the double-acting principle at the turn of the century.

[3]See "Foundations in Permafrost" by Col. William C. Gribble, Jr. [M.E. Nov.-Dec. 1960] and "Polar Engineering, A Summary" [M.E. Jul.-Aug. 1961].



Model of the Completed Aerospace Medical Center

Buildings constructed are: 1. Flight medicine laboratory; 2. academic building; 3. research institute; 4. altitude laboratory; 5. research shops; 6. heating plant and cooling towers. Under construction are: 7. professional building; 8. library; 9. bioastronautics-biodynamics laboratory; 10. vivarium support facility; 11. bionucleonics laboratory; 12. heating and cooling plant expansion. Not started: 13. cellular physiology laboratory; 14. dental research laboratory.

Construction of Aerospace Medical Center[1]

By **ROBERT J. FLEMING, JR.**
Major General, Army Corps of Engineers

ADOLF KROEBER
Colonel, United States Air Force

and

GEORGE L. HAHN
Lieutenant Colonel, United States Air Force

PROBLEMS peculiar to the space age confronted the engineers who designed the seven new buildings that are being added to the Air Force Aerospace Medical Center at San Antonio, Texas. Terms applied to two of the buildings, "bionucleonics" and "bioastronautics," give a clue not only to some of the types of medical research to be conducted in the buildings but also to some of the special design requirements. These terms, not yet included in the dictionary, were coined to fit the new functions of scientific research which these buildings will house. Lack of precedent and the natural hazards inherent in these types of research accounted for most of the design problems, but soil conditions peculiar to the site further complicated the situation.

Basically, structures had to be provided in which conditions existing in aerospace operations can be simulated and their effects on the physiology and reactions of men and animals can be studied. Here the gamut of conditions will be simulated in a variety of devices and test facilities: high gravity (G) forces, rapid acceleration and deceleration, radiation, extreme cold, extreme heat, extreme pressures both high and low, conditions on the moon, and conditions in craft flying through space. The buildings must be constructed to accommodate these conditions, to permit continuity of operations even in the face of power failure, and to safeguard experiments which may have been operating over extended periods. The sprawling complex of buildings that is emerging on the 60-acre site at Brooks Air Force Base, to fulfill these needs, is being provided through the combined efforts of the Air Force, the Army Corps of Engineers, and some of the leading civilian architect-engineer firms.[2]

The center will have twelve primary operational structures when the current building program is completed. Six of the major structures, having a total of approximately 257,000 square feet of floor space, constitute the first phase of the development, completed in 1959.[3] They include a flight medicine laboratory, research institute building, laboratory shop, altitude laboratory, academic classroom building, and the initial segment of the power plant. The present construction phase[4] is scheduled for completion in

[1]This article was prepared through co-operation of the Army Corps of Engineers, Southwestern Division, Maj. Gen. Robert J. Fleming, Jr., Division Engineer; the Air Force Regional Civil Engineer for the Southwest, Col. Adolf Kroeber; and area, U. S. Air Force, Medical Construction Liaison Officer, Lt. Col. George L. Hahn. These military agencies are working together in engineering and construction of the Aerospace Medical Center's new home at San Antonio, Texas, which is the nation's principal school and research center in the field of aerospace and aviation medicine.

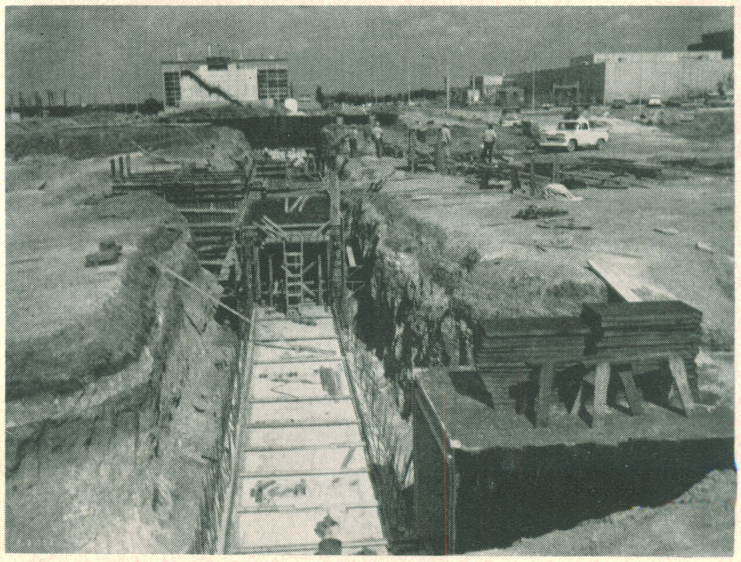
[2]Ellerbe & Company of St. Paul, Minnesota; Associated Architects and Engineers of Texas; and Smith, Hinchman & Grylls, of Detroit, Mich.

[3]Farnsworth and Chambers and Lawless and Alford, contractors.

[4]Browning Construction Company, San Antonio, Texas, prime contractor.

the spring of 1963. It includes a professional building, which will be administrative headquarters for the School of Aerospace Medicine; a bionucleonics laboratory building; a library to house this country's principal collection of books, papers, and research data on aerospace and aviation medicine; a vivarium support building; a bioastronautics-biodynamics laboratory building; a large animal holding structure; and an addition to the power plant. These structures will add approximately 195,000 square feet of floor space.

Exceptionally low background radiation count in some of the construction materials and close tolerances in temperature and ventilation controls for the air-conditioning, heating, and ventilation systems are required. Foundations must allow for a combination of tremendous weights and stresses in an area of unstable soil conditions. The configuration of buildings on the site has had to be planned not only to accommodate present functional needs, but also to allow for expansion which may be needed as technological progress is made in aerospace medicine.



Utility Tunnel to Connect Bionucleonics Laboratory and Vivarium Support Facility

BIONUCLEONICS LABORATORY

One of the most challenging features of the present construction program is the bionucleonics laboratory, a building designed to house the hazardous facilities and functions associated with study of the effects of nuclear and cosmic radiation on living beings. It must have built-in safeguards and equipment for the protection of its workers and for those in the surrounding area as well. At the same time it must provide a specific environment suitable for performing the extremely delicate work involved.

In the supersensitive nuclear section of this building, where whole-body radiation counting will take place, extensive shielding against natural cosmic radiation is essential. Background radiation of the environment itself must be kept to an absolute minimum, to assure complete accuracy in determining radiation count of humans and various biological specimens studied in space research. Every piece of material used in construction must be tested for radiation count which must fall within certain low limits of tolerance. All structural work in the area and on fabrication of lead and steel will be done by burning and welding. The use of oil in machining any part of the steel to go into the shielded zone is prohibited because the radiation count from molecular action in the oil would create conditions inimical to the studies to be conducted.

The shielded area will have three rooms, or cells, inclosed in two laminated layers of 2.5-inch steel plate, lined with ¼-inch lead and encased in concrete 18 inches thick. The steel to be used is aged ship-plate (made for naval vessels) as its aging helps ensure low molecular activity and low radiation count.

The three steel cells forming the shielded area will weigh approximately 180 tons, creating a special foundation problem. The surface soil in this area is a caliche clay material characterized by frequent swelling, contraction, and shifting and extending down approximately 28 feet below grade. To cope with the soil situation, all buildings have drilled pedestal pile foundations, with bell-bottom caissons as supporting members extending to stable material below the 28-foot level. In this heavy portion of the bionucleonics laboratory, the piers will range to 36 inches in diameter and extend to a depth of 40 feet or more, belling out to a width of 9 feet at the bottom.

In a section of this building to be used for hazardous biological research, full precautionary measures must be taken against airborne bacteria, viruses, and other infectious agents. The facilities within this section have been classified into three major areas, depending upon their degree of contamination or hazard:—cold, hot, and extra hot. Cross contamination between and within the groups will be controlled by the use of ultraviolet air locks, reduced air pressures, and non-recirculating ducted air systems. Personnel and equipment going from one group to another will pass through ultraviolet air locks. Materials leaving the building and materials leaving the extra-hot areas will pass through gas and steam autoclaves.

BIOASTRONAUTICS-BIODYNAMICS LABORATORY

The bioastronautics-biodynamics laboratory is another structure whose functions will produce characteristics and stresses which ordinary buildings are not required to endure. It will be the center of research and evaluations of reactions of humans and animals to varied problems of living under simulated space conditions. Here the regeneration of atmosphere under conditions encountered in space will be investigated, and studies will be made on energies encountered in space travel.

This structure will have three main units. One will house a centrifuge area for the study of human and animal reactions to gravity forces. Another, consisting of a high-bay area, will contain space cabin simulators, flight simulators, and a lunar colony, where conditions approximating those on the moon and in space stations will be simulated. The third unit, connecting the centrifuge and the lunar colony, will be a laboratory where effects created in the other two units will be studied and evaluated.

One special problem in the centrifuge area was the design of roof and walls capable of withstanding the terrific aerodynamic currents set up by the rotation and speed of the animal and human centrifuges to be located there. In at least one case, a centrifuge (smaller than the largest one to be located here) created structural damage to the roof of the building in which it was housed. To ensure against such a mishap here,

the centrifuge area is built of reinforced concrete and has a separation of about 1.5 inches from the rest of the building. Its ceiling area is also supported separately from its floor and walls.

The human centrifuge will have a rotor arm 20 feet long with a gondola at the outer end capable of carrying a payload of up to 600 pounds. The gondola chamber will be 9 feet long and 6 feet in diameter. It will be suspended to permit normal anticipated rotation of 0 degrees to 90 degrees. The centrifuge will have a capacity of creating gravity forces up to 50 G's with a rate of onset of 1 G per second and a capability of attaining 50 G's in 60 seconds or less. At maximum G-forces, the gondola will travel at the rate of approximately 85 miles per hour, so the building must be constructed to withstand terrific eddies and currents of air.

Through a combination of tremendous torque created by motion of the centrifuge and the soil conditions at the site the foundation would tend to turn with the centrifuge. To combat this, a base of massive reinforced concrete, 18 feet in diameter and extending to 23½ feet below floor level under the centrifuge, will augment the foundation of the room, which is supported by seven concrete piers with radiating beams.

At the opposite end from the centrifuge area will be the high-bay area housing the so-called "lunar colony." This will be as remote from the centrifuge area as practical, to minimize the transfer of vibration and interference with instrumentation from the centrifuge and other dynamic research equipment. Building plans call for an environmental chamber (with an airlock) in which humans can live under conditions of temperature, humidity, and atmosphere approximating those on the moon. Facilities in this high-bay area will include a rotational flight simulator, which, by the same principle as a ping pong ball on the end of an air hose, will simulate conditions of spatial disorientation and gravity which an astronaut would experience in outer space. The simulator will be air-mounted and capable of rotating in any direction, operating on air bearings.

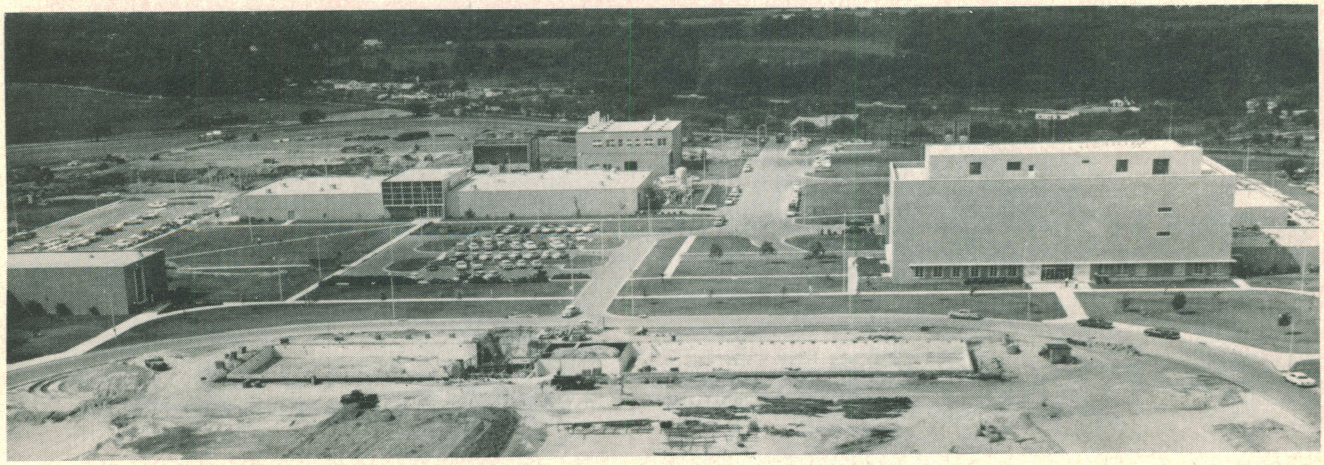
SPECIAL FACILITIES

The first buildings constructed in the Center were not without their extraordinary requirements. One of the buildings has an anechoic room, where a condition approximating zero decibels of sound could be attained for the study of psychological and physiological reactions of humans and animals under conditions of absolute silence. This condition is attained through suspension of a cage-like structure within a concrete-walled room for elimination of outside sound vibrations. The cage is walled with acoustical panels ranging to 3 feet in thickness and arranged in overlapping geometric patterns to absorb sound. The noise level in this room is so low that a person sitting perfectly still can hear his own heart beat.

The maintenance of uninterrupted environmental conditions for long term experiments demands a highly efficient system of utilities. The primary heating, cooling, and air-conditioning system which has been devised for all of the buildings is operated from the main powerhouse through a maze of underground walk-through tunnels. A supervisory data center, where heating and air-conditioning conditions in every area of the center are monitored on a large control panel, will give instantaneous warning of any malfunctions in the system. Augmenting the main power system is a complete standby system under which each of the primary research buildings has its own emergency units which can be placed into service immediately to prevent disruption of operations. In general, the clean or uncontaminated areas are served by different heating, ventilation, and air-conditioning systems from those serving the contaminated areas. The systems in clean areas are maintained at a positive pressure relative to contaminated areas to prevent contamination of the clean areas through infiltration.

Cast-iron water-supply lines will be insulated with sand for protection in the unusual soil at the site. Drain lines for sinks and traps in the laboratories are of glass, to protect them from the action of acids and chemicals poured into the system. In critical areas there are special chambers to hold hazardous radiological and biological wastes to be tested and neutralized prior to their discharge into the sewer system.

In general, the buildings are of typical reinforced concrete and steel frame construction with brick faced masonry exteriors, and are of a contemporary style of architecture. The structures are designed for maximum flexibility to accommodate the changing technological progress in the field of aerospace medicine.



The Aerospace Medical Center under Construction

Professional building in foreground, and ground broken for the vivarium support facilities and the bionucleonics laboratory in the background at left. Completed buildings, left to right, are the academic building, altitude laboratory, heating plant and cooling towers, research institute building, and a portion of the research shops building.

Figure 1. Ferrying Troops across the Main River in Assault Boat

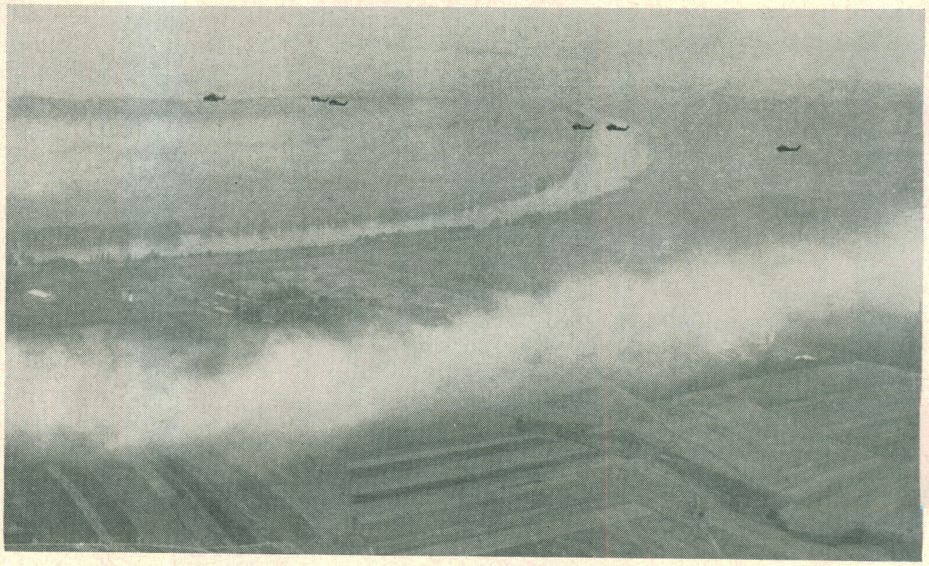


Figure 2. Helicopters Bringing Wave of Assault Troops. Smokescreen Covers Ground Activity

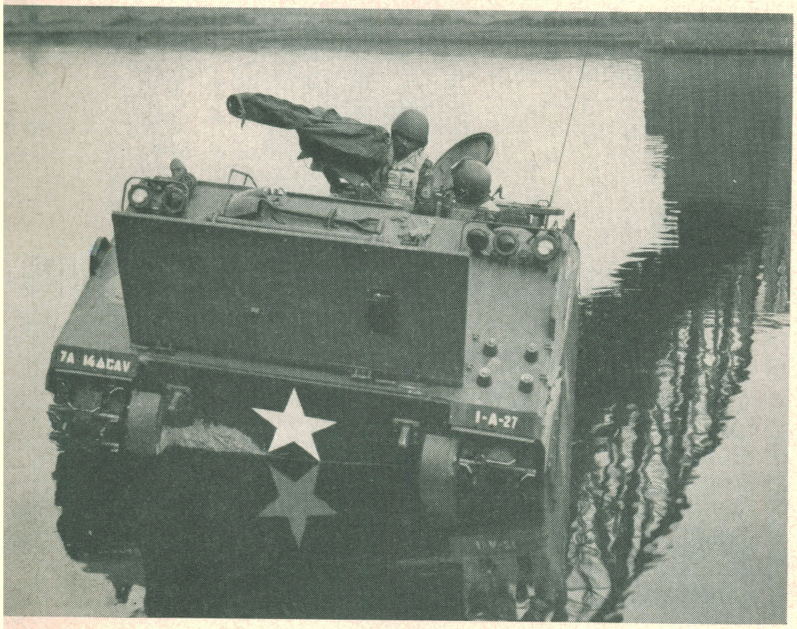


Figure 3. M113 Armored Personnel Carrier "Swimming" the Main

Figure 4. Troops Landing from Helicopters in the Attack

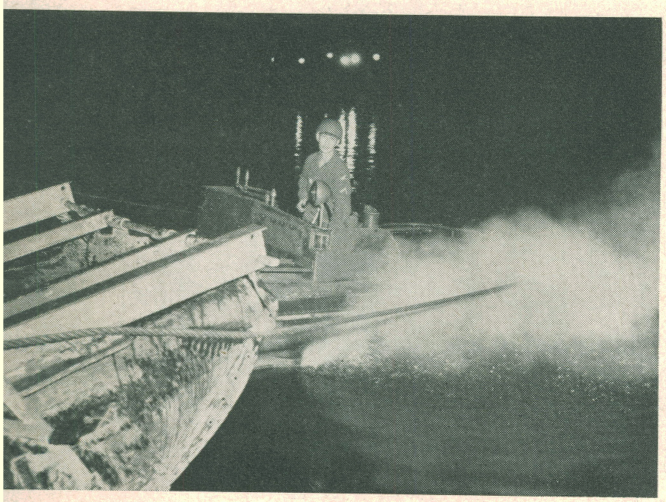


Figure 5. Placing Ponton Section Using Power Boat

Figure 6. Ferrying Tank in River Crossing Operation

Military Engineer Field Notes

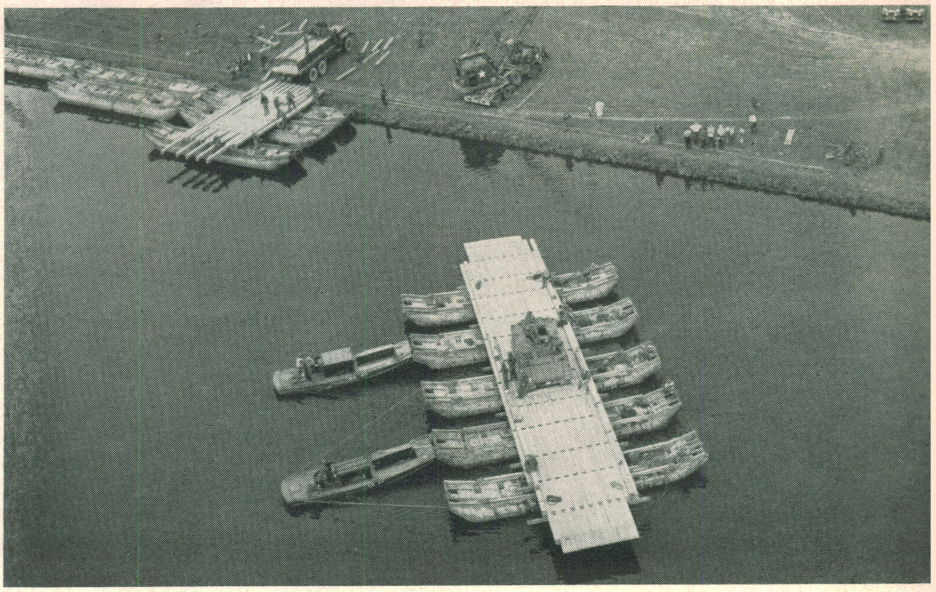


Figure 7. Five-ponton Raft Ferrying Tank while another Raft Is under Construction

Operation BOOTLEG

Rockets and flares and the staccato of Aggressor machine guns met the second wave of infantry crossing the Main River before dawn of D-Day early in September 1961 in Operation BOOTLEG, south of Aschaffenburg, Germany.

In their bulky orange life jackets, the third wave of 1st Battle Group, 7th Infantry, waited in the bushes back of the west bank of the river for their turn to cross. Crowded into assault boats (Figure 1), they met no resistance on the east bank, nor did the fourth and final wave, in their action to seize initial bridgeheads for the 37th Engineer Group.

With the arrival of daylight the river villages from Klein Wallstadt to Obernau, a distance of 10 kilometers, were covered by man-made fog (Figure 2) to mask the engineers preparing to build two ponton bridges for the tank spearhead of the 14th Armored Cavalry. The operation was conducted to test the combat building capacity of the 37th Engineer Group,[1] and it was the Annual Army Training Test for two of its battalions, the 9th Engineer Battalion (Combat) and the 299th Engineer Battalion (Combat).

The second phase of attack was conducted with the new model amphibious armored personnel carriers of the 14th Armored Cavalry. It was the first time the unit had tried the M113 vehicle (Figure 3) in place of the former M59 in the water. The test proved the lightweight aluminum vehicle to be faster than the old one in water as well as on land.

Swarming like bees, seven H-34 helicopters of the 54th Transport Battalion (Helicopter) airlifted a company of the 7th Infantry across the river in two waves for the third phase of the attack (Figure 4). Two H-37 helicopters followed with a cargo of four jeep-mounted 106mm recoilless rifles.

The engineers received word that the first line of objectives had been seized and that the companies in the assault had moved out toward the second line. By 7 a.m. the bridgehead was considered secure enough for the builders to start constructing rafts to ferry the tanks into action.

[1]Col. Robert P. Boyd, Jr., commanding.

Supplied by the 502d and the 814th Engineer Float Bridge Companies, inflated rubber pontons were lifted into the water by large wheeled cranes.

Twenty-seven-foot power boats lined the pontons in place (Figure 5). Atop the five-ponton rafts were placed 15-foot aluminum balk to make up the roadway for the tanks. A balk section will float by itself although it weighs 225 pounds.

The combat engineers ferried the tanks and heavy vehicles (Figures 6 and 7) across the river all day, seriously hampered by Aggressor air activity. At one point, the umpires ruled that a bombing run by an Aggressor plane had punctured the three center pontons of a raft under construction. The 9th Engineers had to deflate the pontons, remove them, insert new deflated pontons, and then inflate them.

With nightfall came the opportunity to bridge the Main. The 9th and the 299th battalions each built a bridge (Figure 8). They worked from both banks, and connected the bridging in the middle of the river. The 9th Engineers used their rafts as sections for the M4T6 floating bridge, which was 475 feet long and 22 feet wide. Both bridges could support vehicles of

Figure 8. Tank Crossing on Ponton Bridge

up to 60 tons. (A combat-loaded M48 tank weighs 52 tons.)

Thus the 37th Engineer Group proved its capabilities in solving a serious water barrier problem.

Wabash Bailey Bridge

By Col. John P. McWhorter and
Maj. Carl J. Bordiga, Corps of Engineers

The east span of a three-span bridge over the Wabash River, serving the town of Clinton, Indiana, collapsed on October 4 when an automobile collided with one of the main truss members. Loss of the bridge made necessary a considerable detour for residents of the area, which was particularly serious because the hospital in Clinton serves a large population on the other side of the river. Other bridges are located at some distance to the north and south.

On October 6 a request came from the Governor of Indiana to the Fifth Army commander for assistance in providing an emergency bridge at Clinton. In response, the 113th Engineer Battalion,[2] 38th Infantry Division, Indiana National Guard, was assigned the work of construction.

The Wabash River at Clinton is about 365 feet wide at water level. It was initially estimated that a floating bridge would be required so as not to interfere with reconstruction of the demolished span. However, after some consultation, it was decided that reconstruction in the form of a three-bay prestressed-concrete girder bridge supported on wooden piling would be possible under a Bailey bridge if a minimum of 18 inches clearance were provided. The use of a Bailey instead of a floating bridge would eliminate the need for a large maintenance detachment while the temporary bridge remained in place.

The collapsed span measured 180 feet 6 inches between the abutment on the east shore and the pier, which also supported the middle span of the bridge.

[2]Lt. Col. Alfred P. Torrenga, commanding.

The Marion, Ohio, Engineer Depot was ordered to ship out 200 feet of Bailey bridge and necessary erection tools and equipment. The bridge was loaded on railroad cars on October 10 at Marion, and arrived in Terre Haute, Indiana, some 15 miles from the bridge site, at 6:45 a.m. on the 12th.

Meanwhile, Company A (reinforced) of the 113th Engineers moved to Rockville, Indiana, some 11 miles east of the bridge site, and set up headquarters in the Armory. Unloading and transportation of the bridge began immediately on its arrival, and construction started that same day. The 200-foot double-triple Bailey was completed on the afternoon of October 16.

Some unique problems were encountered in the construction of this panel bridge. The center line of the bridge had to be established with extreme accuracy so that the panel bridge, 19 feet 11 inches wide, would pass between the main batter posts of the existing center span of the bridge; the critical clearance between posts measured just 20 feet (Figure 9). Each time the bridge was advanced across the gap it moved off center. To keep it in place, a chalk line was drawn in the center of the transom in the first bay of the launching nose, and a transit located in the center of the existing span was sighted on this line continually to maintain direction as the bridge was launched. One D-8 tractor was used to move the bridge forward; another maneuvered at the side of the bridge on the shore to adjust the alignment. This adjustment continued until the first few bays of the launching nose had passed the far pier rocking rollers.

Positioning of the panel bridge on the far pier also presented a challenge. The pier required reinforcement to support the load of the bridge, which in itself weighed 130 tons. The area on the pier was insufficient to accommodate the rocking rollers and bearings and base plates. Concrete curbing on the existing span had to be removed to make room for the cribbing and base plates. Base plates for the end bridge bearings should be placed at least 2½ feet and preferably another foot or two from the rocking rollers. This re-

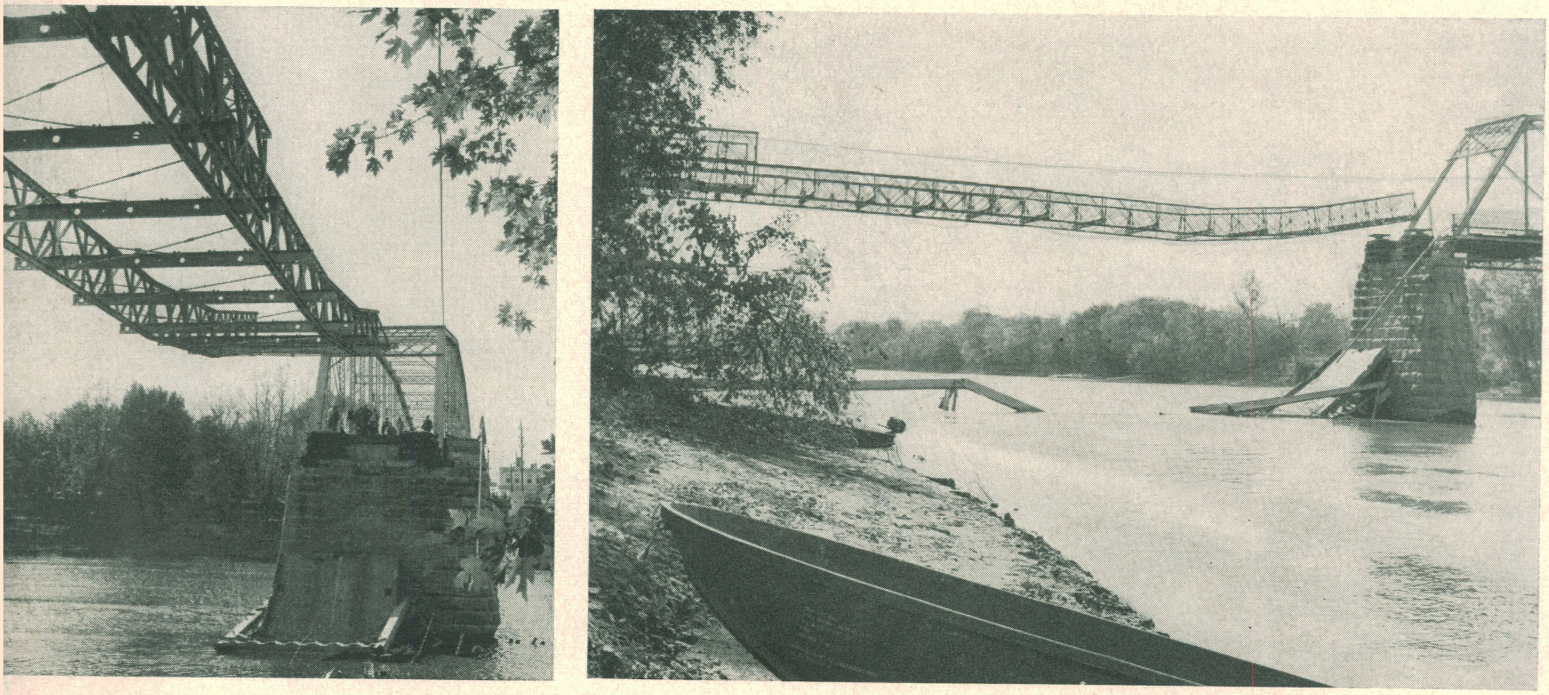


Figure 9. Launching Nose Approaching Pier, Note Critical Clearance, left photograph, and Rollers Placed on Cribbing, right.

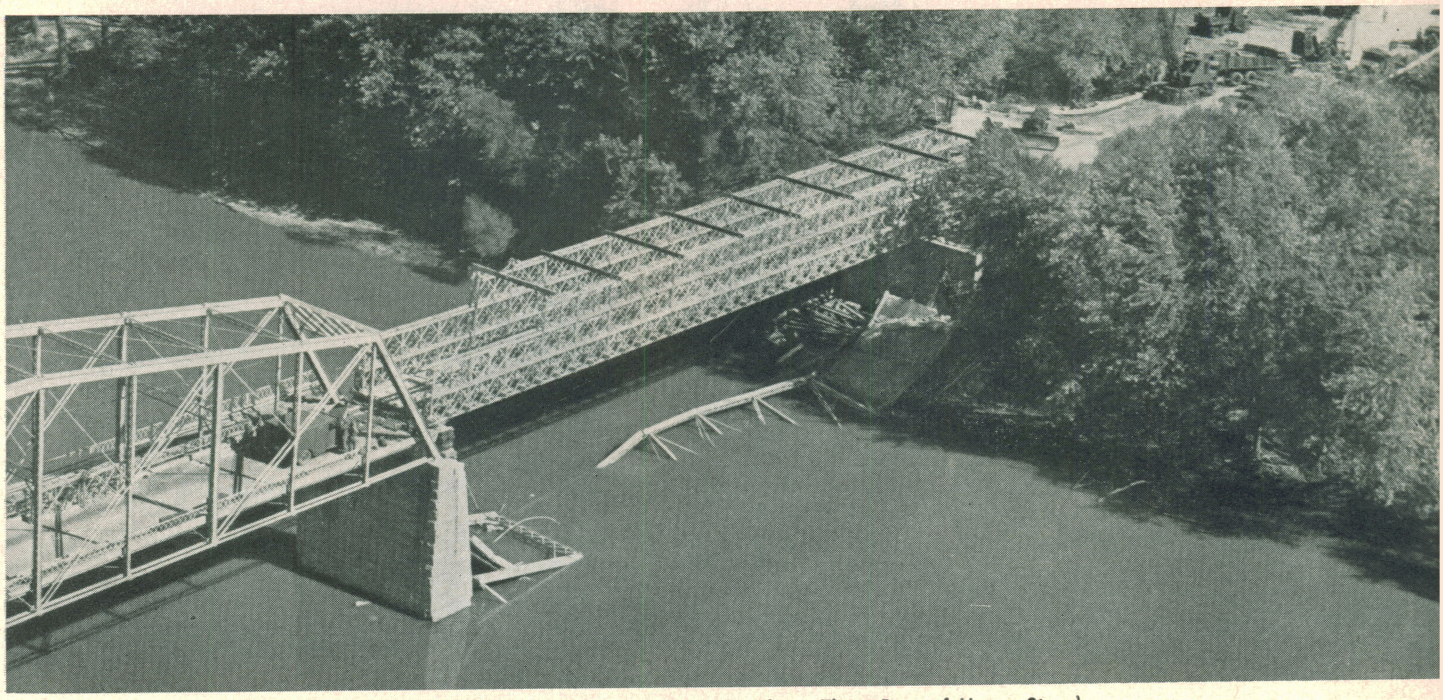


Figure 10. Aerial View of the Completed Bailey Bridge (Less Three Bays of Upper Story)

quired construction of additional cribbing on the shelf of the pier to position the rocking rollers properly (Figure 9), which in turn enabled the base and bearing plates to be placed directly over the reinforced section of the pier.

Unusual conditions were involved in the jacking operation. Instead of jacking the bridge off the rollers and down to a position lower than the rollers, as in most panel bridge operations, this bridge had to be jacked to a height above the rollers. The bridge, therefore, had to be elevated from the jacks and cribbed sufficiently to maintain the 18-inch working clearance for the construction of a new span beneath it. The ten mechanical jacks needed to lift the far-pier end of the bridge could not be used because of the restricted working area. Six mechanical jacks at the end posts and four additional hydraulic jacks of 12-ton capacity were inserted at each side under the panels near the rocking rollers to make the lift. Extreme care had to be taken to raise the bridge evenly with the different types of jacks, and the deflection at the center of the bridge had to be calculated to obtain the prescribed clearance at this point. Each end was cribbed to a height of 26 inches to compensate for deflection at the center of the span.

Because of an immediate shortage of bridge parts, including overhead bracing supports and transoms, it was necessary to improvise some of them. When overhead bracing supports are used normally on three-story bridges they are placed one per girder on each bay of the bridge. This establishes a vertical vehicle clearance of 14 feet 4 inches. When overhead bracing supports are not used the panels of the third story must be inverted so that transoms may be inserted in an underslung position, and in this arrangement a 12-foot vertical clearance is provided. Since shortages of these parts existed, 10-inch I-beams were placed on top of the panels (Figure 10), and thus a 13-foot clearance was obtained. The I-beams were modified by drilling 1¾-inch diameter holes in the flanges, and they were connected to the top panels with chord bolts. A sleeve made of 2-inch-diameter pipe was used to take up the slack on the chord bolt.

Considering the adverse weather conditions, a restricted working space, and the fact that half of the work force had never constructed a panel bridge before, the time of 34 working hours for completion of the structure was excellent. A trained crew under ideal conditions can construct a bridge of this type and size in approximately 16 hours. The capacity of the bridge span under normal load conditions is rated at 20 tons.

Among the visitors to the site were a group of Engineer ROTC cadets from nearby Rose Polytechnic Institute (Figure 11). The cadets received a short training lecture with a model of the panel bridge erected at the site for this purpose, and observed the actual construction of the bridge.

This bridge not only provided a very essential emergency crossing of the Wabash at Clinton, but also presented an excellent training exercise for the 113th Engineer Battalion.

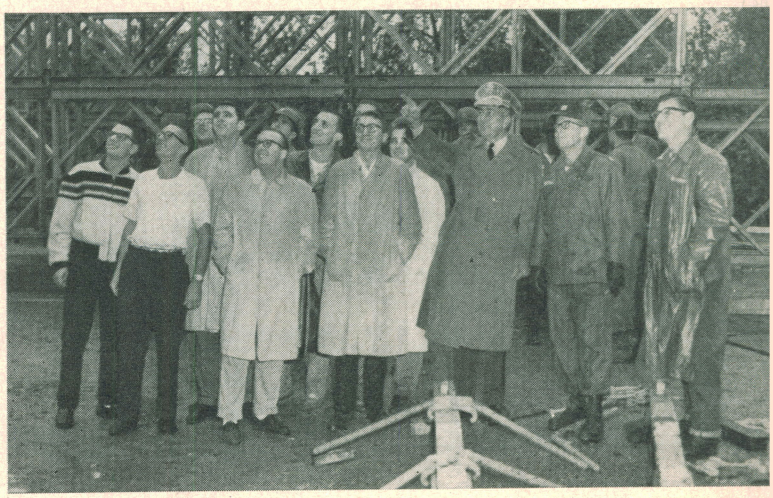


Figure 11. Engineer ROTC Students on Visit to Bridge Site

Large Blast Load Generator

By DANIEL L. LYCAN
Captain, Corps of Engineers

SINCE the advent of nuclear weapons, underground structures have become practically a necessity for the protection of weapons, personnel, and equipment. The ability of the United States to retaliate after an enemy nuclear attack depends upon the safety of its strategic missile bases, and it is therefore necessary to place them in underground structures.[1] The Army Corps of Engineers, as the engineering and construction agency for the Army and the Air Force, is engaged in a missile base construction program that is one of the largest and most complex tasks it has ever undertaken.[2]

Although full-scale tests of the effects of nuclear explosions on underground structures have been conducted, there is a need for laboratory testing and evaluation of designs and for verification of design procedures. The present ban on full-scale weapons tests has added impetus to the need for laboratory testing facilities. Recognizing this fact the Army Engineer Waterways Experiment Station at Vicksburg, Mississippi,[3] has developed a large dynamic testing device for use in developing and evaluating protective structures designs.[4] It is called the Large Blast Load Generator (LBLG) and it will be used to test small-scale buried structures and soils under loads similar to those created by a nuclear explosion.

In the design of protective structures, the radiation, thermal, and blast effects of a nuclear explosion must be considered. Protection against radiation and thermal effects can usually be provided by adequate thickness of suitable shielding materials. Therefore, the most significant factor in a structural design is the blast effect. In normal structural design problems, only static loads are considered, but in the design of protective structures, consideration must be given to the dynamic effects of the blast loading from a nuclear explosion. (The load is applied rapidly and decreases in magnitude in a relatively short time.)

FEASIBILITY STUDY

In planning the LBLG it was decided, for practical reasons, to limit the device to one that would test soils and buried structures.

The following requirements were established for the LBLG: the test bin should be at least 16 feet long, 16 feet wide, and 10 feet deep; peak pressures should range from 20 to 1,000 psi; rise time of the pressure pulse should range from a few milliseconds to 30 milliseconds; and the duration of the pressure pulse should be from 15 milliseconds to several seconds. The dimensions of the test pit were selected so that a relatively large portion of the test area would be free of the objectionable side effects caused by the lateral confinement of the soil mass by the walls of the test pit. It was anticipated that small-scale structures with spans up to 5 or 6 feet would be tested. The pressure levels and time durations were selected so that a large variety of nuclear weapons could be simulated.

Several methods of obtaining the specified requirements were investigated. Some of the ideas explored included a tilted blast simulator of the type developed by the Navy;[5] a compressed mixture of gases in a pressure vessel; detonation of blocks of explosives on the surface of the soil sample; and a converging shock channel which, by means of rapidly converging sections, would cause a shock front to pass over the test area. Each approach was studied to determine the problems involved in producing the desired pressures, in confining the pressure and test specimen, and in reliability, safety, and reproducibility of experiments.

A feasibility study[6] indicated that the blast wave pressure characteristics of nuclear explosions could be reproduced and that a testing facility for conducting experiments on soils and buried structures was practicable. The testing facility envisaged (Figure 1) was essentially a large pressure vessel formed by three

[1]See "Protective Construction—A Summary," [M.E. July-Aug. 1960].
[2]See "Missile Construction for Security," by Lt. Gen. E. C. Itschner [M.E. July-Aug. 1959], and "Construction—Vital to Security," by Lt. Gen. E. C. Itschner [M.E. Mar.-Apr. 1959].
[3]The principal Corps of Engineers laboratory engaged in research in the field of nuclear weapons effects on structures, terrain, and waterways.
[4]See "Military Engineering, 1961: Nuclear Combat, Missiles, Space," by Maj. Gen. S. R. Hanmer [M.E. Jan.-Feb. 1961].
[5]See "Atomic Blast Simulator," by J. R. Allgood and W. A. Shaw, [M.E. Jan.-Feb. 1959].
[6]By Boynton Associates of La Canada, California.

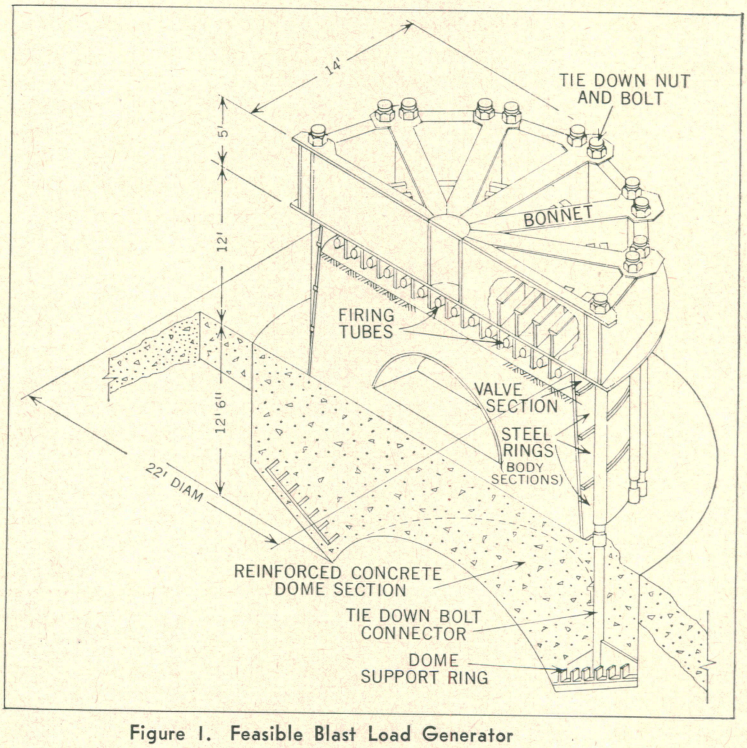


Figure 1. Feasible Blast Load Generator

cylindrical steel rings stacked one atop the other and tied together by steel bolts. (Three rings are used for ease in assembly and disassembly.) To provide a test area 16 by 16 feet, each ring has an inside diameter of about 23 feet.

In the top of the pressure vessel there is a parallel array of firing tubes which produce the overpressures on the soil surface. The firing tubes are thick-walled steel pipes with numerous holes drilled in the walls throughout the entire length. Explosives (primacord appears to be the safest and most reliable) are placed in the tubes, and when detonated the hot, high-velocity gases which escape through the holes cause a rapid rise in pressure in the top of the vessel. A grid (or baffle) system made of steel plates is placed between the tubes to break up the individual shock waves produced by each tube, so that a smoothly rising pressure is applied to the top of the soil.

The peak pressure is controlled by the amount of explosives used. The rate of decay of the pressure is controlled by a number of quick-opening exhaust valves located around the periphery of the upper ring. These solenoid-actuated valves are opened at various times on a predetermined schedule to obtain the desired pressure decay. An exponentially decaying pressure-time curve comparable to nuclear blast pressures can be produced. The firing tubes and exhaust valves provide an easily controlled, readily reproducible, and reliable dynamic load.

When the tubes are all fired at the same time, the soil surface will be subjected to an instantaneous loading representing the load that would result from the reflected blast wave in an actual nuclear explosion. However, at a certain distance from the point of explosion the shock wave travels transversely across the ground surface and the "Mach-stem" type of loading results. By detonating the tubes in rapid sequential order the effects of such a transverse wave can be simulated, so that it will be possible in the generator to study the effects of an instantaneous loading as well as a traveling shock wave.

The top of the pressure vessel is formed by a heavy bonnet fabricated of thick steel plates. The firing tubes are attached to the underside of the bonnet which is secured to the flat-top, reinforced-concrete dome base by large vertical bolts and nuts. The bolts are threaded into connector rods attached to a steel support ring in the base. The base, being subjected to a downward force in the center and to upward forces around the edge, must resist primarily a compressive loading rather than a shear loading.

The size of the generator components depends upon the pressures which are to be produced. At first, it was desired to develop pressures up to 1,000 psi. The difficulties involved in fabrication, stress concentrations, and economic factors made it desirable to accept a generator of 500-psi capacity. This peak pressure level required a generator with rings fabricated from T-1 steel plates, 2½ inches thick, a bonnet weighing approximately 100 tons, and twenty-four tie-down bolts 9⅜ inches in diameter.

EXPERIMENTS

The design of the LBLG was initiated in August 1959. A generator capable of producing a peak pressure of 250 psi was built for use in a limited experimental program to provide additional information. This generator (Figure 2) is made up of two roughly

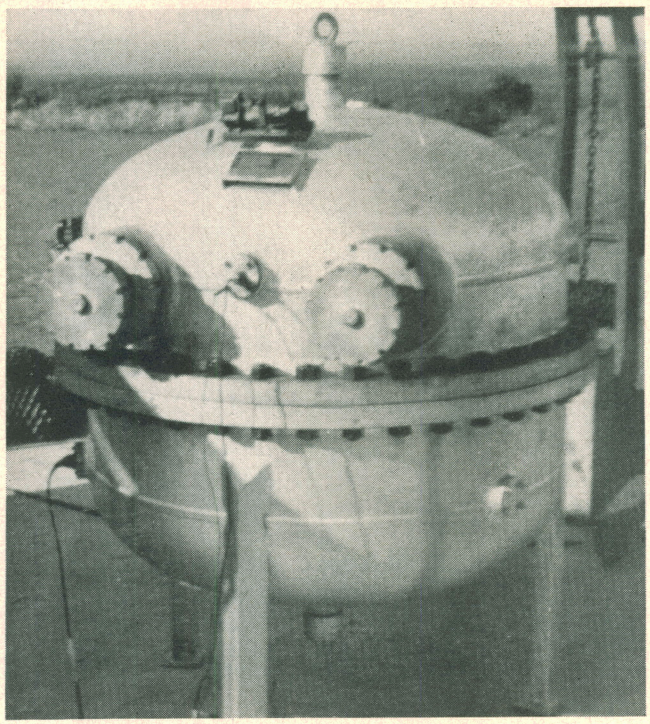


Figure 2. Experimental Blast Load Generator

hemispherical steel shells, 4 feet in diameter and $\frac{9}{16}$ inch thick, joined together in the center by forty 1⅛-inch bolts passing through flanges. Two firing tubes and two quick-opening exhaust valves are provided in the upper half of the generator, and gage ports for instrumentation are provided in both shells.

For a test in the generator, soil is placed in the bottom, the top section is bolted on, and the firing tubes are loaded with primacord. A disc-type controller automatically starts the recording equipment, detonates the explosives, and opens the exhaust valves at the preselected times.

The fifty-seven tests conducted in this generator were devised to obtain information about the arrangement and type of baffles, methods of obtaining reliable sequence firing and increasing the pressure duration, the effects of gas absorption by the test soil, and the effect of various types of soils on the design forces.

In all tests, primacord was found to be a safe and reliable explosive, giving consistent results in successive tests conducted with the same amount of explosive. Sequential detonation of the firing tubes was achieved by placing various lengths of a mild detonating fuse between the blasting cap and the booster charge in each tube.

The duration of the pressure pulse depends upon the heat loss from the hot gases to the walls of the generator and also on the openings of the exhaust valves. Even if the valves remained closed, the pressure would decay according to the rate of heat transfer from the gases to the steel plates of the generator and to the soil. For long pressure durations it is necessary to provide some type of pressure sustainer. The material selected is a solid rocket-propellant placed in pellet form in the firing tubes with the primacord. Thus, the duration of the peak pressure can be extended from a few milliseconds to several tenths of a second.

Tests were conducted in the experimental generator on samples of sand, silt, and clay to determine the

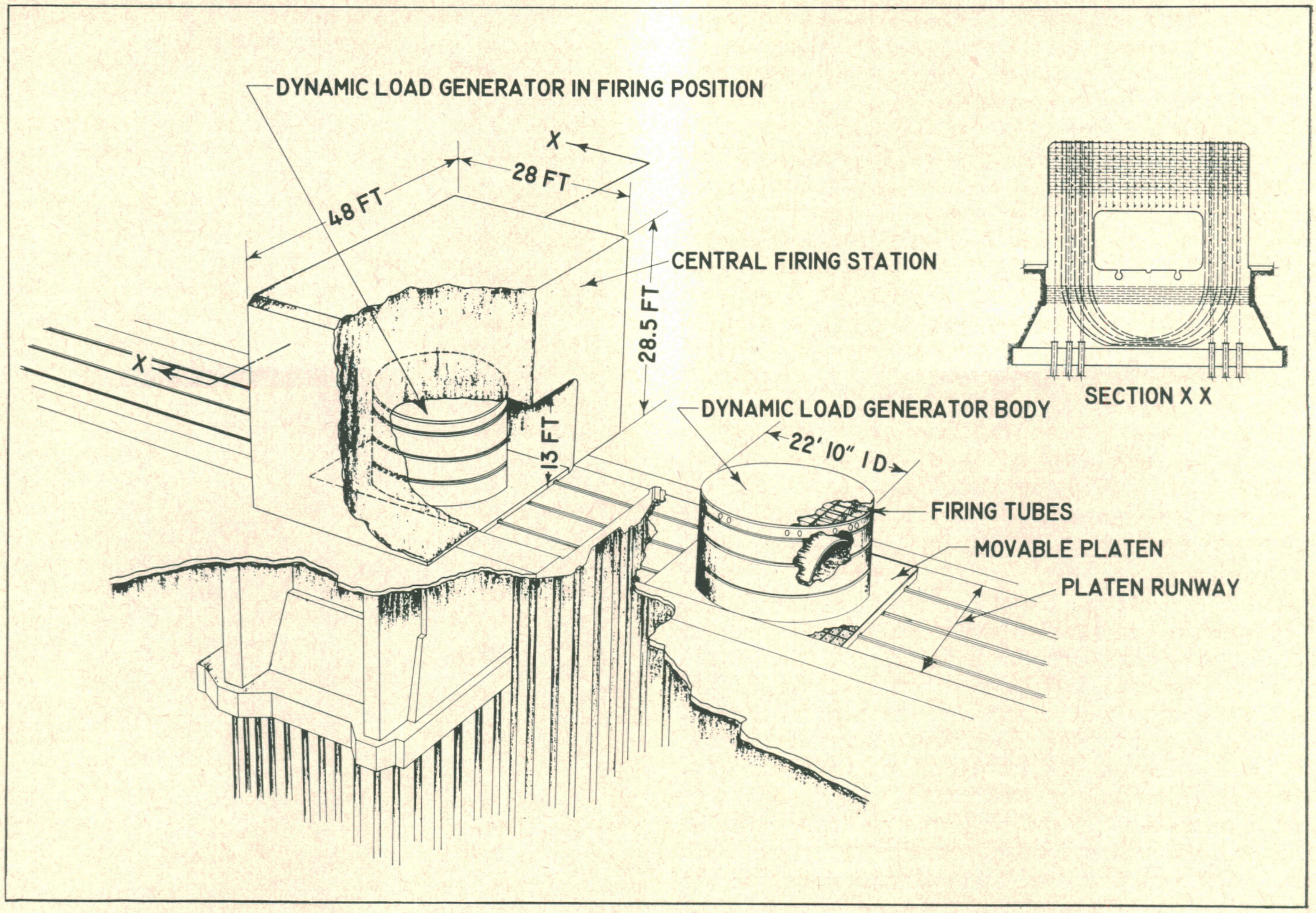


Figure 3. Final Design of Blast Load Generator

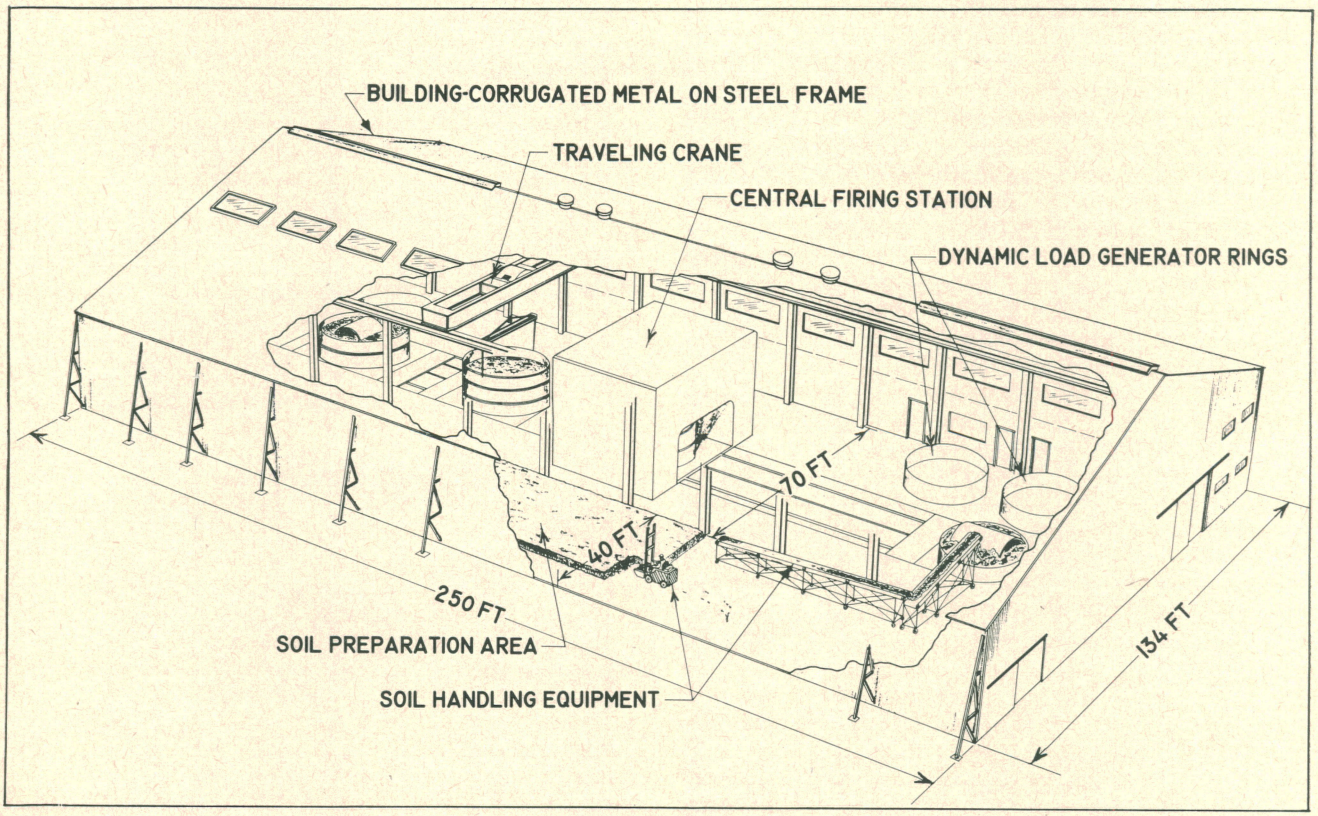


Figure 4. The Blast Load Generator Facility

effect of varied soil types. In the test on a silt sample, the generator tended to rise from its foundation because of the high compressibility of the loose silty material, or, more precisely, because of the low velocity of wave propagation in the silt. If the propagation velocity in the soil sample is very slow, the developed pressures will act on the upper surfaces of the generator for some period of time before the pressures can be transmitted through the soil to the lower surfaces. Thus, until equal forces are acting on both the top and the bottom of the generator, it will be subjected to an unbalanced force causing an upward thrust, which requires special considerations in the foundation design.

Tests were also conducted on several firing tubes to determine the amount of explosives that safely could be detonated inside the tubes. It was found that the loading of primacord required to produce the maximum peak pressure of 500 psi was well within the loading capacity of the tubes.

FINAL DESIGN

The feasibility study indicated several features which appeared to present severe operational difficulties. The assembly of the generator would consist of stacking the rings on top of each other and placing the test structure and soil sample at the same time; setting the bonnet and firing tube assembly on top of the rings; placing the bolts through the bonnet and threading them into the connector rods; and, finally, threading the nuts on the top of the vertical bolts. One can imagine the difficulties that could be encountered when it is noted that each bolt would be about 20 feet long and weigh 3 tons, each nut would weigh about 250 pounds, and the steel-plate bonnet would weigh approximately 100 tons. Expansion of the facility would also be difficult and expensive since a new base dome and an extension of the building and craneway would be required for each new generator.

In view of these problems a new type of facility was considered. Instead of having to handle the heavy reaction structure (the bonnet and bolts) for each test, it was proposed to have a fixed reaction structure and a movable chamber containing the soil and test structure. The final design offers considerable operational advantages and provides for more economical future expansion. In order to increase the testing range it will be necessary only to provide additional test chambers since the single reaction structure does not have to be duplicated.

The LBLG consists of the central firing station, which is a massive post-tensioned, prestressed concrete structure designed to provide the reaction for the large dynamic loads developed in the test, and a test chamber which is a cylindrical steel bin containing the soil and structural specimen to be tested. (See Figures 3 and 4.)

TEST CHAMBER

The test chamber consists of three steel rings fabricated from T-1 steel plates 2 inches thick. Each ring is 3 feet 4 inches high and has an inside diameter of 22 feet 10 inches. The rings have beveled edges so that they interlock when stacked. A fourth, or upper, ring assembly is made of two cast steel rings with the top ring sliding in a machined and gasketed annular slot in the bottom ring so that the top can be raised and lowered. The quick-opening exhaust valves are located in the walls of the upper ring and a ¼-inch plate is welded over the top of the upper ring.

The firing-tube assembly contains a parallel array of fifteen tubes placed in a rigid framework of perforated cylindrical baffles. The entire assembly can be lifted and placed in position in the upper ring assembly.

The lateral thrust of the chamber is transferred to the central firing station through eight screw-jacks attached to the outside of the upper rings and extended to bear on steel plates embedded in the walls of the central firing station.

To move the test chamber in and out of the firing station, the test chamber is assembled on a platen which rolls on rails in the floor. The movement of the platen is controlled by a cable. The section of track rail inside the central firing station is separated from the rest of the rail system and is located in a trough in the floor. This section of track can be lowered about 1 inch. When the rails are lowered, the platen rests uniformly on the floor of the central firing station so that the thrust developed during a test is transmitted directly to the floor and not through the wheels and rails.

CENTRAL FIRING STATION

The 3,000-cubic-yard central firing station is of prestressed concrete designed as a rigid frame using static loads and a dynamic response factor. Various possible loading conditions and the corresponding deflection modes were analyzed. The rigid-frame analysis was made in accordance with the usual elastic theory; but because of the large depth of the top slab there was some doubt as to its accuracy. Therefore, a photoelastic analysis was made. Although there were high stress concentrations at the interior corners with the greatest concentrations along the sides, the stress values obtained in the photoelastic study generally agreed with the elastic analysis values. To reduce these high stresses an elliptical corner fillet was used.

Since the central firing station will deflect under the applied load and then rebound, causing stress reversals, prestressing was used to prevent the concrete from being subjected to tensile forces. Two different stressing systems are used. The upper slab has stress rods 1¼ inches in diameter placed in all three directions. Vertical stress rods are placed in the side walls and are anchored to the foundation piling. A horizontal cluster of stress rods is also placed in the bottom slab. Stranded-steel cables, $1\ ^{11}/_{16}$ inches in diameter, pass through the side walls and the bottom slab and are anchored on the top of the central firing station.

The size of the central firing station and the magnitude of the forces involved can be realized by considering that in the prestressing system approximately 20,000 feet (60 tons) of 69-wire stranded-steel cables, 75,000 feet (175 tons) of stress rods, and 45 tons of 1½-inch bearing plates for the end anchorages will be used. About 60 tons of ordinary reinforcing bars and structural steel sections also will be used to support the rods and cables during construction operations. Each of the cables, approximately 120 feet long, will be tensioned to 260,000 pounds and the rods will be tensioned to 135,000 pounds.

The weight of the firing station when the test chamber is inside (about 7,000 tons) and the soil conditions at the proposed location made it necessary to use a pile foundation. The 272 steel H-section piles

will be driven approximately 100 feet to bedrock. The firing station and the platen runway are founded on bearing piles while the building columns are on friction piling. Approximately 39,000 lineal feet (1,350 tons) of steel piling will be used for the foundations.

The design of the foundation of the central firing station presented an unusual problem because of the tremendous upward forces that may occur. (See Figure 5a.) The slowest propagation velocity observed during the experimental investigations was 400 feet per second. This means that for a soil sample 10 feet deep, it will be 1/40 second before the pressure reaches the bottom of the test chamber. During this period there is a net upward force of 30,000,000 pounds for the maximum pressure of 500 psi.

An analysis was made of the action of the central firing station under these dynamic loads in order to determine if the pile foundation would be adequate to resist the uplift. It was approximated by a single-degree-of-freedom, spring-mass system (Figure 5b). The rigid mass, M, represents the mass of the central firing station and the test chamber; the spring with a spring constant, k, represents the resistance of the piles to vertical forces; and the force, $P(t)$, represents the net force acting upward for a period of time of 25 milliseconds (1/40 second).

This dynamic analysis indicated that the maximum anticipated deflection would be about ¼ inch. Each pile would be subjected to a downward force of 100 tons and an upward force of 42 tons. Skin friction of the piles developed sufficient resisting forces, but, to prevent any vertical movements, the piles will be firmly anchored into the base and some of the outer piles will be driven on a batter to provide lateral support and additional resistance to uplift.

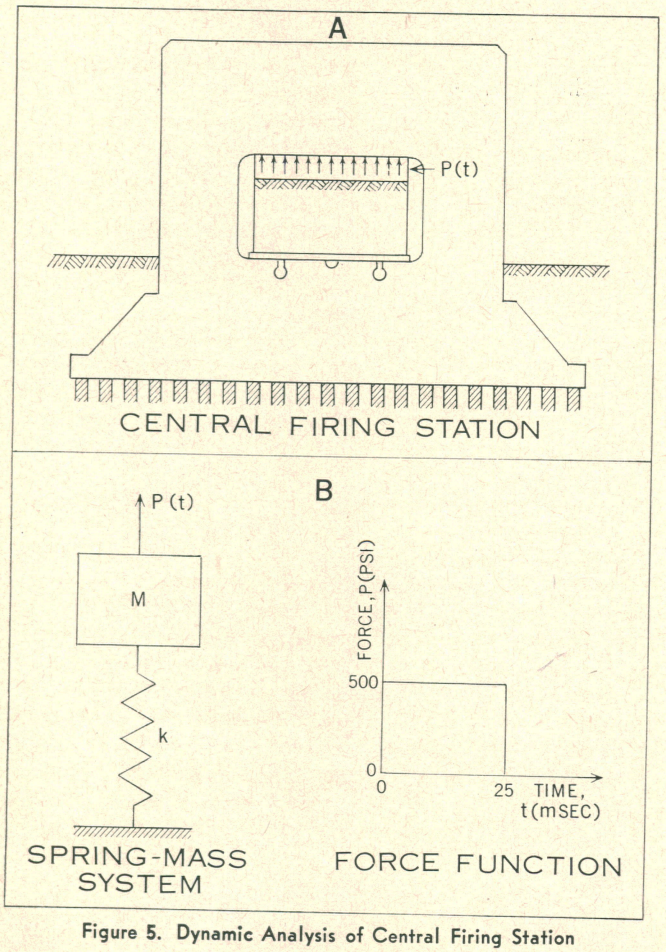


Figure 5. Dynamic Analysis of Central Firing Station

OPERATION

For operation the test chamber (Figure 3) is assembled on the platen with the test structure, soil, and instrumentation in it. To fill the test chamber to a depth of 10 feet will require the handling and preparation of 150 cubic yards of soil. The upper ring and the firing tube assembly are set in place to complete the test chamber. The platen is then pulled into the central firing station. The rails inside are lowered by a dual-wedge system and the upper part of the top ring assembly is raised until the top of the test chamber bears against the bottom of the top slab of the firing station. The horizontal jacks are extended to the side walls of the central firing station. The detonating circuit is connected to the primacord in the firing tubes and the wiring to the exhaust valves, and the instrumentation is connected. Starting the recording equipment, detonating the explosives, and opening the exhaust valves in proper sequence will be effected automatically at a control console. After the test, the lateral jacks are withdrawn, the top ring assembly is lowered, the rails are raised, the platen is pulled out of the central firing station, and the test chamber is disassembled.

CHARACTERISTICS

The facility (Figure 4) has sufficient space for four test chambers in various stages of preparation, testing, or dismantling. In addition to the principal parts of the generator, areas for soil preparation, instrumentation, and offices are included. Major items of support equipment include a 50-ton overhead traveling crane, a 10-ton overhead traveling crane in the soil preparation area, and soils handling equipment.

The Large Blast Load Generator is to have the following characteristics:

Peak pressure—20 to 500 psi.
Time to peak pressure—minimum ½ millisecond.
Duration of pressure—up to about 2 seconds.
Available surface area for dynamic loads—446 square feet.
Available depth for soil and test specimen—10 feet.
Velocity of air-pressure wave—from the speed of sound in air to instantaneous loading of the entire surface area.

Under these specifications, blast pressures from nuclear weapons in the kiloton and megaton ranges can be simulated.

Tests will be conducted in the generator to determine the relation between the various soil and structural parameters that may be important in the design of underground structures. The stress attenuation properties of soils and the interaction of structure and surrounding media will be investigated. Evaluation tests can be conducted on blast closure valves, shock isolation materials, entranceway designs, and blast doors. It will be possible to conduct tests to establish statistical reliability of data. Various soil types may be investigated without the necessity of moving the test site.

The LBLG, currently under construction at the Waterways Experiment Station, is scheduled to be completed by May 1962. It will be the largest dynamic testing device of its kind. After the generator has been proof-tested, other tests will be made to obtain data needed for the efficient, economical, and rational design of underground protective structures.

Editorial

Management and the Military Engineer

Rear Adm. E. J. Peltier

IT IS doubtful if any professional man has been so profoundly affected by the scientific advances that have occurred since World War II as has the military engineer. Charged with the planning, design, construction, and maintenance of facilities for the military services, he finds himself today involved in the building of a military establishment that his predecessors could not have imagined twenty years ago.

He must plan in terms of radically changing weapons systems based upon the nucleus, the missile, and space. He must utilize new types of equipment and new materials. He must undertake the construction of projects that are entirely without precedent. He must adjust his operations to the use of electronic computers which can handle the more prosaic aspects of his work most efficiently.

In addition, he must accomplish his mission under conditions that are new in the history of our nation. Specifically, for the first time, the end of a war has not meant the beginning of a peace, but rather the start of a period of suspended military animation in which the minimum acceptable effective force extracts from the national economy its maximum continued effort. This requires a facility concept of a more durable nature than the lath and tarpaper structure which satisfied military engineering requirements of earlier times.

Another point for consideration is that the weapons and the equipment for which the engineer must provide facilities all are in the early stages of development. Thus, revisions in their design are frequent and often drastic. This places upon the military engineer the necessity to produce designs for the facilities and equipment so that changes in the weapons can be accommodated with a minimum of alteration.

Faced with these difficult demands, how can the military engineer measure up to them?

First, he must have sound engineering knowledge. The unfamiliar, the unprecedented project may seem to present insurmountable obstacles merely because it is new and different. But the underlying principles of engineering are not subject to change. Invariably, the knowledge and application of these rules will provide a solution and perhaps a precedent for the projects to come. Therefore, the engineer's education must never stop.

Second, he must be adaptable. He must at all times retain an open mind and be willing to take new and different measures to accomplish the job at hand. He must be ready to accept ideas that are strange and to study them without prejudice lest he leave a stone unturned in finding the solution to his problem.

Third, and not least in these days of military austerity, he must be thoroughly versed in management techniques. It is no longer sufficient to think of a military engineer solely in terms of technical competence and technical proficiency. Technical skills in the engineering profession are an essential ingredient, but they can no longer be the only ingredient.

The military establishment must now be so organized that its readiness for action can be measured with a stop watch, not with a calendar. Yet in preparing that military establishment for any eventuality the military dollar must be stretched to the utmost. This combination of requirements can be fulfilled most satisfactorily if engineering and management capabilities are effectively welded together.

Increasing the effectiveness of an engineering task is essentially a management problem. The military engineer should be able to utilize the basic principles of management and their application to engineering problems just as he utilizes the basic principles of engineering and analytical thinking to the application of management problems. Both engineering methods and management methods are required.

The military engineer of today must always be cognizant of basic management principles and should be able to apply them to the management of engineering tasks. He should understand the necessity for adequate organization, planning, scheduling, work improvement, and performance evaluation in addition to the technical and engineering requirements of a particular task. Training and human relationships also become involved in this interplay of management and engineering.

There is the contention by some engineers that in accepting the obligations of management the engineer risks losing his professional status. This can happen only if professional ethics and practices are overruled by management decisions. No sensible engineer would advocate such a situation or permit it to prevail. Engineers, and particularly the military engineers, constantly demonstrate the fact that no one is better qualified than they to exercise management control over engineering projects. This exemplifies a professional attitude that is needed today for positive action.

E. J. Peltier
Rear Admiral, Civil Engineer Corps,
United States Navy
Chief, Bureau of Yards and Docks

Regulation of Lake Ontario

By ERNEST J. DENZ
Major, Corps of Engineers

THE President of the United States and the Queen of England met on the shore of the St. Lawrence River near Montreal, Canada, on June 26, 1959, to participate in ceremonies marking the official opening of the St. Lawrence Seaway and Power Project. Appropriately, they hailed the work as an outstanding engineering achievement and as a splendid example of two countries working together in peace and harmony. They spoke of the expected benefits to navigation and of their effects on commerce and industry, as well as the contribution that the newly constructed hydroelectric power project would make in meeting demands for electrical energy. But they did not mention another highly significant fact —that construction of the project introduced the need for artificial control of the outflows of Lake Ontario.

The manner in which the outflows from Lake Ontario are controlled will have a far-reaching effect on the use of the Great Lakes-St. Lawrence River system. Proper control can eliminate excessively high or low levels of the lake, and can enhance the use of the navigation works by ensuring sufficient depths for navigation. It can enable the power plants to be operated under optimum conditions. On the other hand, it may not be possible to control the outflows from the lake so as to provide the most desirable conditions at all times and for all purposes.

NATURAL CONDITIONS

Lake Ontario, the smallest of the five Great Lakes, has a water surface area of approximately 7,540 square miles. Being the lowest in the Great Lakes chain, it receives the combined outflow of the others, the main flow being over Niagara Falls and through the gorge of the Niagara River and a smaller amount through the Welland Canal, constituting about 85 percent of the inflow. River systems such as the Genessee, the Oswego-Onondaga-Seneca draining the Finger Lakes, the Black with its headwaters in the Adirondacks, the Trent draining the Peterboro Lakes, and innumerable lesser systems provide the remainder of the inflow. The net total supply to the lake—all of the water reaching the lake minus evaporation losses —has averaged 241,000 cfs and has varied from 135,000 cfs to about 419,000 cfs.

During the past 100 years, the average elevation of the water surface of Lake Ontario has been 246.04 feet on U. S. Lake Survey 1935 Datum.[1] To the engineer studying regulation methods, the long-term average level of the lake is of importance, but the manner in which the short-period average lake levels vary is of even greater interest. Each year, these variations have followed a definite seasonal cycle. The maximum average lake level has occurred usually in June, with the minimum occurring in November or December.

[1]This is roughly the height above sea level, but actually Lake Survey datum is referred to mean water level in New York City harbor.

The magnitude of the annual change in lake stage has not been constant from year to year. The average change has been about 1.5 feet, but in 1867 the change from summer high to winter low was almost 4 feet, and in 1915 this change was only about 0.7 foot. The highest monthly mean level on record is 249.29 feet which occurred in June 1952, and the lowest monthly mean level, which occurred in November 1934, is 242.68 feet, making a total range of about 6.6 feet.

The St. Lawrence River is the outlet for the entire Great Lakes drainage basin, which is about 295,000 square miles of which approximately 95,000 square miles is water surface. The vast size of the basin and the tremendous storage capacity of the lakes have regulated the flow in the St. Lawrence River to an unusual extent. The maximum recorded monthly mean flow is 314,000 cfs while the minimum is 154,000 cfs. Flows in other rivers of comparable size vary much more widely.

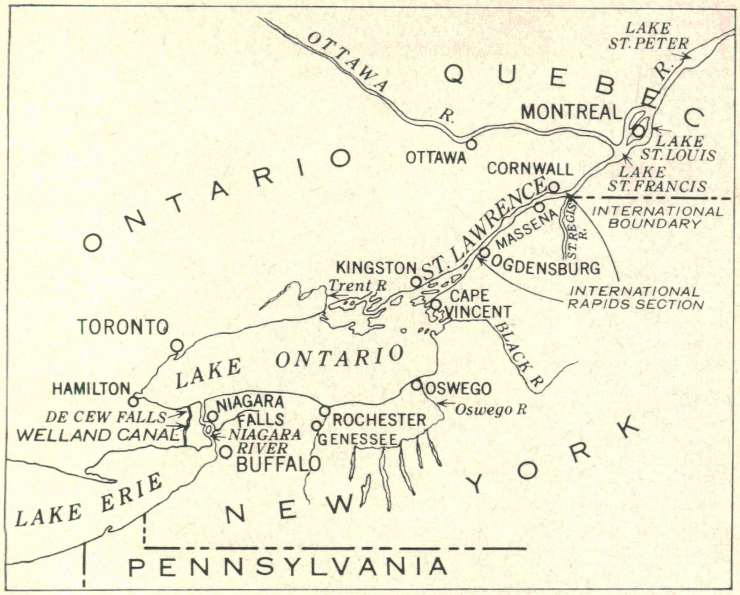
DESIGN OF REGULATION PLAN

Regulation was started in April 1960, under a plan known as Plan 1958-A. It is too soon to evaluate results of the operation so far, but the development of the plan and its purpose can be described.

The designers of the regulation plan had to take into consideration the millions of users of the Lake Ontario-St. Lawrence River water system, the levels and flows to be regulated, the variety of needs and preferences, and the ports, industries, and homes on the shores. Another major factor is the shipping fleet and the millions of tons of cargo involved. A final factor affecting the design of the plan is the hydroelectric development and its needed water supply. Therefore, it was necessary to establish twelve different criteria to be met, so that all interests would be safeguarded.

RIPARIAN INTERESTS

Almost all of the shore property owners on Lake Ontario can express their requirements rather easily because conditions which are adverse to them are caused primarily by excessively high or low lake levels. Consequently, for them the most desirable regulation plan would keep the lake level at or near the long-term average level, about 246.0 feet. But this procedure would require maintaining outflows equal to incoming supplies which could at times amount to well over 400,000 cfs. Such high outflows would be objectionable to other affected interests. As the lake level rises above a certain stage, shore property becomes increasingly vulnerable to flooding and, if severe storms occur while the lake level is above this stage, there may be heavy damage due to wave action. In addition, storm winds generally superimpose a temporary local rise on the mean lake level which may overtop protective beaches and structures.



Lake Ontario Locality Map

In view of these conditions, it was extremely difficult to establish a definite critical lake level from the standpoint of damage to shore property. It was estimated that this level is between elevations 248.0 and 249.0. The regulation plan was designed so that the regulated monthly mean lake level would not exceed elevation 248.0, and the frequency of occurrences of monthly mean levels of approximately 247.0 feet and higher under regulation would be less than the frequency of these occurrences in the past. The lower limit was established at elevation 244.0 during the navigation season for the benefit of navigation interests. This elevation was also acceptable to the riparian owners. Thus, under regulation, the range of Lake Ontario stages is intended to be limited to about 4 feet rather than the range of 6.6 feet that had been recorded under natural conditions.

The requirements of riparian owners below the International Rapids section of the St. Lawrence River, and particularly on the shores of Lake St. Francis, Lake St. Louis, and in the Montreal area are more complicated than those of Lake Ontario property owners. Lake Ontario provides considerable storage capacity and, therefore, changes in average lake levels occur slowly; but there is no comparable storage capacity available downstream so that rapid fluctuations in water levels caused by changes in outflows from Lake Ontario are commonplace. The only significant storage capacity that is available is provided by Lake St. Francis which has an area of 90 square miles and a storage capacity of about 1,000 cfs per month per foot of depth, and Lake St. Louis which has an area of 56 square miles and a storage capacity of 600 cfs per month per foot of depth. It would require a depth of approximately 133 feet on Lake St. Louis to provide the same storage as 1 foot of depth on Lake Ontario; hence, Lakes St. Francis and St. Louis have very little moderating effect on Lake Ontario outflows.

The Ottawa River flow is divided by the group of islands in the Montreal area but a large portion joins the flow of the St. Lawrence River at Lake St. Louis and subsequently flows past Montreal Harbor. Since the flows from Lake Ontario and the Ottawa River affect water levels in Lake St. Louis and Montreal Harbor, any regulation plan devised for Lake Ontario must take the Ottawa River conditions into account. This is particularly important because the Ottawa River is almost invariably at flood stage in late spring.

The unique ice conditions in the Montreal area impose stringent restrictions on Lake Ontario regulation. Early in the winter, at the entrance to Lake St. Peter which is located about 50 miles downstream from Montreal Harbor, an ice pack forms which builds upriver and enters the harbor proper. As this happens, the thickening ice retards the flow in the river in increasing amounts and the water level in the harbor gradually rises. When the ice has packed upstream beyond Montreal, the water level, which has risen some 10 to 20 feet, remains fairly constant for the rest of the winter. When the spring breakup occurs, large quantities of surface ice and slush float downstream from the Laprairie Basin above Montreal, enter the harbor, and add to the ice jam. This can cause a large rise in water level, typically about 20 feet. In addition to the possible damage from flooding, a further threat is caused by the force exerted by the jamming and grinding ice itself.

When the Ottawa River is in flood, or when serious ice conditions exist in Montreal Harbor, interests downstream cannot tolerate increases in Lake Ontario outflows. At such a time, the people on Lake Ontario could coincidentally be having high-water problems of their own, and would resist decreasing lake outflows just as strongly as the people downstream would resist increasing them. Moreover, the period of the year during which serious ice conditions can develop in Montreal Harbor coincides with the time when increased outflows from the lake could benefit power production. These examples show how the requirements of one group can be in conflict with the requirements of others affected by the regulation plan.

To safeguard the rights of downstream interests, the regulation plan included the stipulation that during the period of annual flood discharge of the Ottawa River, and when serious ice conditions exist in Montreal Harbor, the outflow from Lake Ontario is not to exceed the outflow that would have occurred without regulation.

Another requirement arising because of downstream conditions involves avoidance of lowering Lake Ontario outflows. Situated in one of the most densely populated regions of Canada, Lake St. Louis annually attracts thousands of visitors who make extensive use of its waters for boating, swimming, and fishing. Water from the lake is also used extensively for domestic purposes and sewage disposal. During periods of low water people bent on recreation, those who own property on the shores of the lake, and those who depend on the lake for water supply could be seriously hurt if the Lake Ontario outflows were curtailed. Therefore, a minimum flow limitation, effective from late May to late September, was included in the regulation plan.

NAVIGATION REQUIREMENTS

Navigation interests are primarily concerned with minimum depths of water available for vessels, and naturally want the minimum regulated lake level to be relatively high. Similarly, outflows should be high to insure satisfactory water levels for navigation

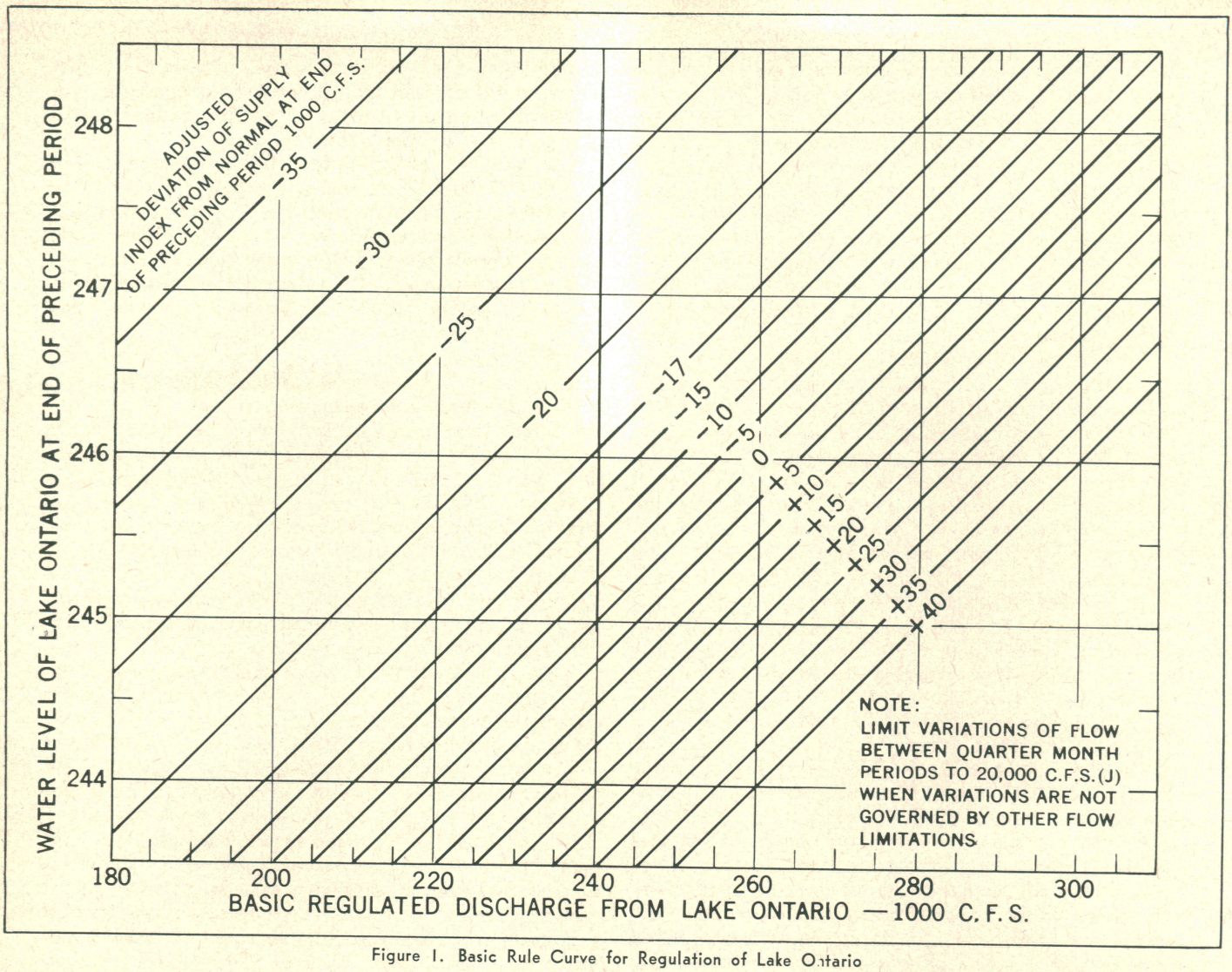


Figure 1. Basic Rule Curve for Regulation of Lake Ontario

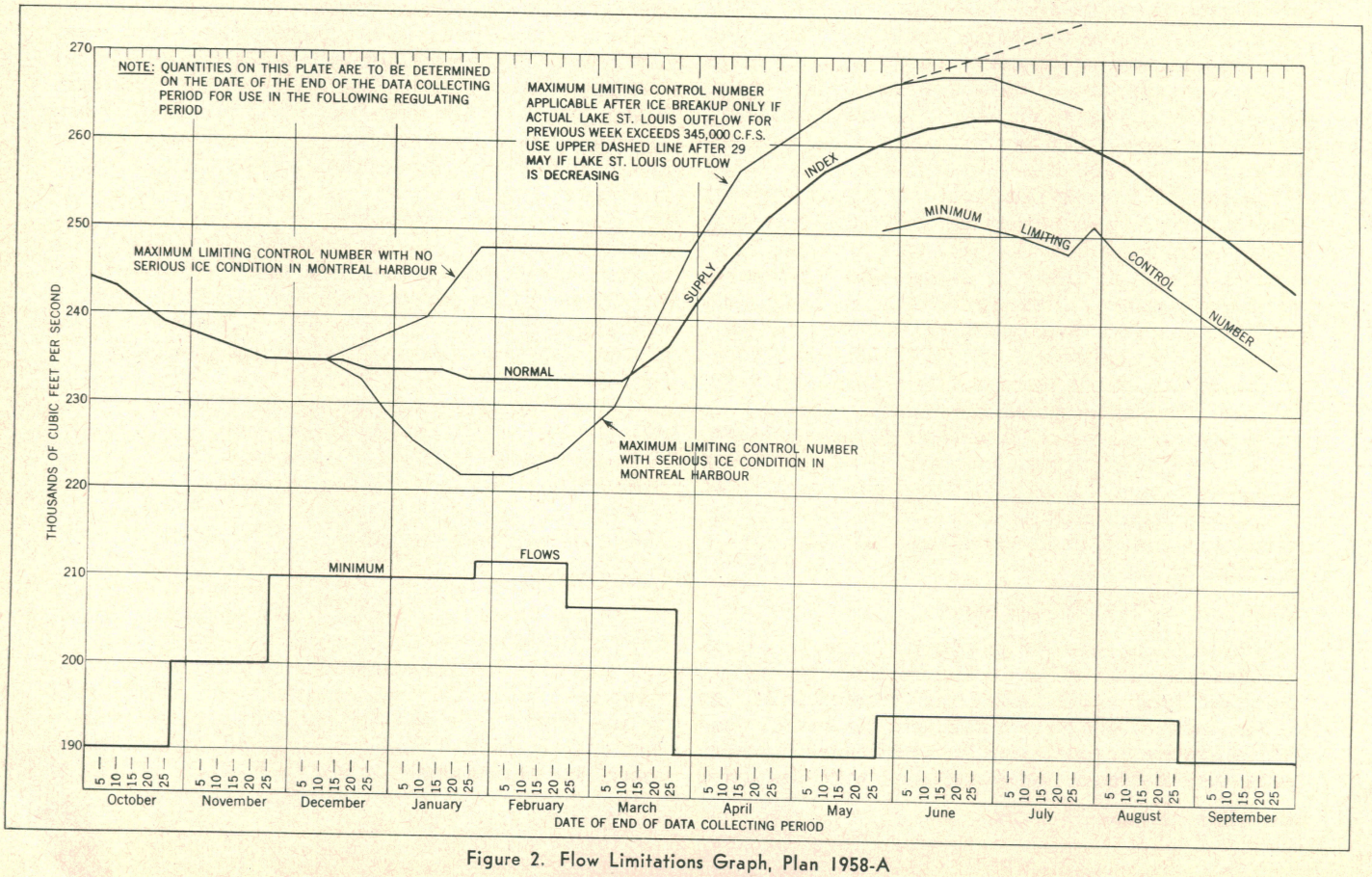


Figure 2. Flow Limitations Graph, Plan 1958-A

downstream. At Montreal Harbor, for example, a change of flow in the harbor of about 20,000 cfs will result in a change in water level of 1 foot. Thus, comparatively small lowerings of minimum flows can result in significant decreases in depths available for vessels. Excessively high lake levels can adversely affect navigation structures, and outflows which are too high will cause objectionable currents and velocities in the St. Lawrence River for navigation.

The monthly mean lake level of 248.0, established primarily for the benefit of riparian interests, proved acceptable also for navigation. The plan provided that the regulated level of Lake Ontario on April 1 would not be lower than elevation 244.0, and that the regulated monthly mean level of the lake from April 1 to November 30 (assumed to be the navigation season) would be maintained at or above 244.0. To ensure adequate velocities and depths for navigation in the St. Lawrence River, the plan provided that the maximum permissible flow of water that could be released from Lake Ontario at any given lake level would result in a profile of the river surface downstream that would not be lower than the profile used for channel design. Minimum flows were established primarily for the benefit of power generation with the understanding that they would also be satisfactory for navigation.

POWER NEEDS

Although the most beneficial regulation plan for power generation is one that would provide for high lake levels and high minimum outflows, it must also permit temporarily decreased flows during the winter months if necessary to facilitate formation of an ice cover or to reduce the effects of ice jamming. However, since power load requirements are greater during the winter months than in any other season, minimum flows in winter should be as high as possible consistent with the other requirements.

The United States-Canadian Treaty of 1909 provides with respect to boundary waters that the order of precedence for use of these waters shall be (1) for domestic and sanitary purposes, (2) for navigation, and (3) for power. Consequently, the power interests had to accept the upper and lower limits of lake levels that were established primarily for the benefit of riparian and navigation interests. Likewise, flow limitations established for the protection of these same interests downstream had to be accepted. Nevertheless, it was possible to include in the plan at least one feature that was primarily for the benefit of power: minimum flow limitations of 190,000 cfs to 212,000 cfs, the higher values being in effect during the winter when there is the greatest demand for power.

The plan is sufficiently flexible to permit decreased flows of unspecified magnitude and duration during the winter months if such decreases are necessitated by ice conditions, particularly if flows required by the normal application of the regulation plan are higher than 220,000 cfs.

TECHNICAL ASPECTS OF THE PLAN

The procedure followed in designing the regulation plan consisted of testing various methods of regulation using data recorded from 1860 through 1954. As the various methods were tested and the results analyzed, undesirable characteristics and needed improvements were detected. Some methods were discarded as unfeasible; others were revised and tested again. This process of elimination, revision, and testing led to the development of Plan 1958-A as the initial plan of regulation for Lake Ontario.

The basic rule curve for the plan is shown in Figure 1. The rule curve is a series of straight lines plotted to indicate the regulated outflow from Lake Ontario as a function of lake level and an adjusted deviation of a computed supply index from normal. However, it is necessary to use more than the basic rule curve to determine the regulated outflow applicable during a given regulating period. The outflow as determined from the basic rule curve must be compared with certain maximum and minimum flow limitations which may be in effect. If the outflow as determined from this curve falls between the maximum and minimum flow limitations, it is adopted as the regulated outflow, but if it falls above or below the maximum or minimum limitations, the applicable limitation is adopted as the regulated outflow. The various flow limitations, shown graphically in Figure 2, are also available in tabular form.

The device of using an adjusted deviation of a computed supply index from normal was adopted to provide a means for varying regulated outflows according to some indication of future water supply conditions. It is possible to obtain such indication by considering the magnitude and sequence of the supplies which have reached the lake during the recent past. Since about 85 percent of the total water supply to Lake Ontario consists of outflows from the upper lakes, this component of the supply varies slowly and accurate forecasts of it are practical. The remaining 15 percent varies erratically, making this component difficult to predict. However, the procedure finally devised worked very well when the plan was tested.

Actually, a supply index computed in accordance with instructions contained in the plan is nothing more than a very good approximation of the pre-project outflow from Lake Ontario that would have occurred under the same supply conditions during the particular regulation period. Comparison of a computed supply index with the normal supply index (average pre-project outflow) for the same period gives an immediate indication of the nature of existing supply conditions. On the other hand, the difference of the supply index from the corresponding normal index will not give an indication of the trend of the supply conditions. Consequently, a procedure to adjust the deviations of supply indices from normal was adopted to take the supply trend into account. The adjustment is made by computing the changes in deviations of the supply indices from normal for a period of thirteen weeks, averaging the changes for the last four weeks (to avoid giving too much weight to isolated values), and multiplying the result by two-thirds. The value obtained is then added algebraically to the deviation of the supply index from normal to obtain the adjusted deviation.

CONCLUSION

The full value to be added to the worth of the seaway and power project because of the ability to regulate Lake Ontario's outflows can only be estimated at this time. The matter of regulation will continue to be the subject of study by engineers and their associates in the United States and Canada in a constant search for improvement.

Ewing's Approach in the Siege of Vicksburg

By EDWIN C. BEARSS

THE failure of his massive assault on Vicksburg on May 22, 1863, convinced Maj. Gen. Ulysses S. Grant that the Vicksburg fortifications were too strong to be carried by *coup de main*. If the Federals were to capture the key stronghold, they would have to resort to siege operations.

On May 25 Grant issued an order directing his three corps commanders to "commence the work of reducing the enemy by regular approaches." The engineers would take advantage of the rugged configuration of the terrain to gain positions from which to "start mines, trenches, or advance batteries." Grant's chief engineer, Capt. Frederick E. Prime, would be responsible for the siege operations.

Captain Prime shook his head over this assignment. At the time, there was only one other officer belonging to the Corps of Engineers who was serving in an engineering capacity with the army. He was the Chief Engineer for the XIII Corps, Lt. Peter C. Hains. It would not be possible for Prime and Hains to superintend individual projects without neglecting their other duties. Consequently, these technical works would be supervised by officers with an engineering background who were serving as *aides de camp* or in the line.

Enlisted personnel to do the engineering chores were more plentiful. Besides Bissell's Engineer Regiment of the West and Patterson's Kentucky Company of Engineers and Mechanics, several infantry divisions had pioneer companies. These units would be assisted by fatigue parties from the infantry commands and Negro work gangs. The working parties would construct gabions and fascines, throw up batteries, and dig saps.[1]

In all, the Federals pushed thirteen approaches toward the frowning Confederate works.

CONDITIONS AT VICKSBURG

The soil in the Vicksburg areas is loess, which made digging easy. Cuts in this material, if sloped correctly, will stand for years. When mining operations were undertaken, shoring was not necessary.

All of the six roads leading into Vicksburg followed ridge lines, and to protect them the Confederate engineers had laid out nine major works connected by a line of rifle pits and battery positions.

The Graveyard road (along the watershed separating the head of the Mint Spring Bayou from the North Fork of Glass Bayou) was guarded by Stockade Redan. Two smaller works, the 27th Louisiana Lunette and Green's Redan, flanked the large redan. A poplar stockade closed the gap between Stockade Redan and the Lunette on its left, and through a gate in this stockade the Graveyard road entered the Vicksburg defenses.

The ridge tops and hillsides in the area were under cultivation; the hollows were overgrown with trees and underbrush. Prior to the approach of Grant's army, the Confederates had felled most of the timber. The ravines fronting the fortifications had been turned into a formidable abatis.

In the Graveyard road sector, Maj. Gen. William T. Sherman's XV Corps drove three approaches (Buckland's, Ewing's, and Lightburn's) toward the vital Stockade Redan. More time and labor were devoted to Ewing's Approach than to the others, because it was considered to be of the greatest strategic importance.

Ground on Ewing's Approach was broken May 23. The initial purpose of the works was to provide a covered route to the line of rifle pits which the Federals had thrown up on the ridge 100 yards east of Stockade Redan.[2] Fatigue parties from Maj. Gen. Francis P. Blair's division (50 men to the shift) were detailed to work on the project. These infantrymen were spearheaded by the pontoniers of Company I, 35th Missouri, who quickly made the transition from pontonier to sapper. Working under cover of darkness, the Federals pushed their approach (parallel with the Graveyard road) toward Stockade Redan.

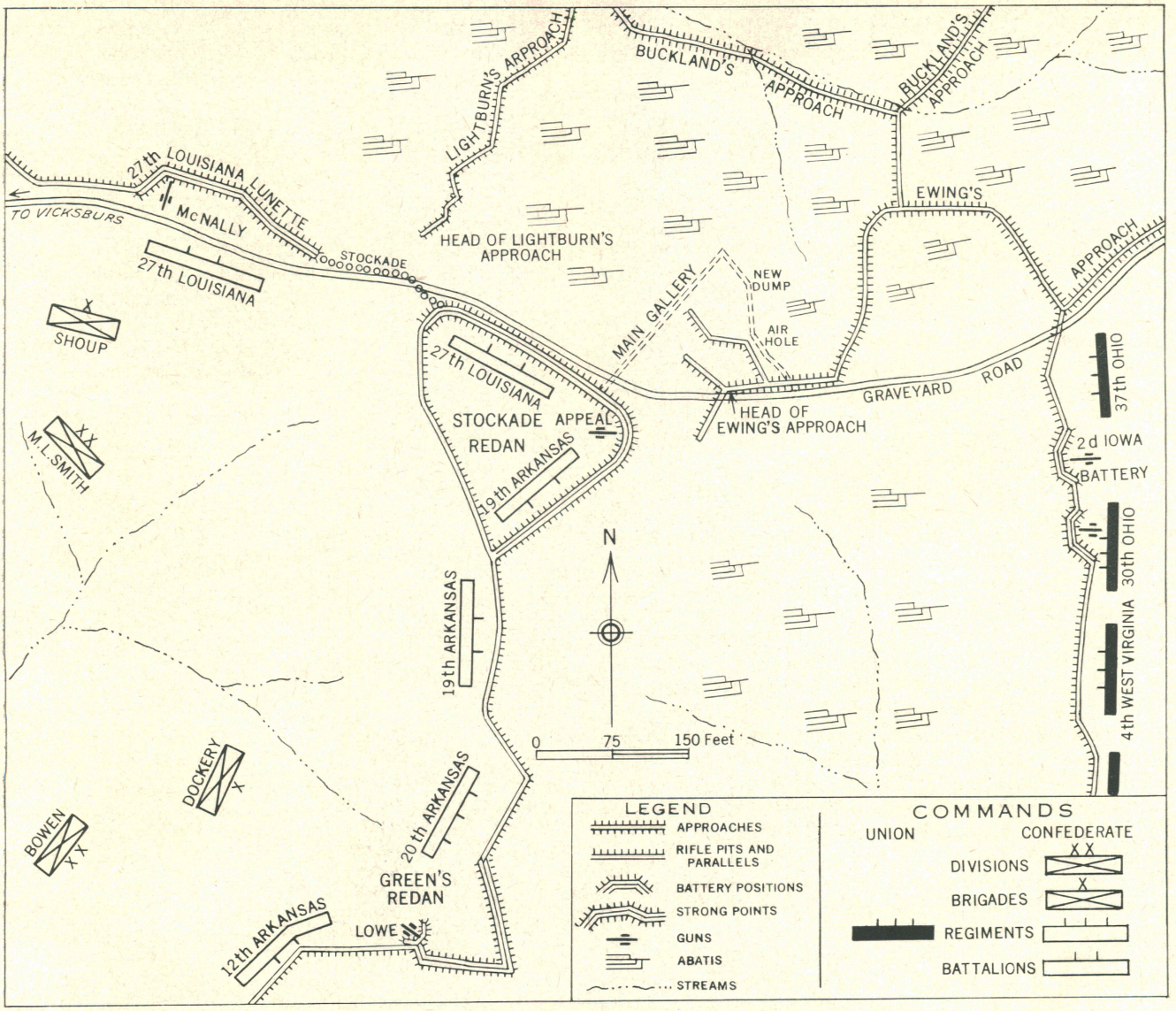
Meanwhile, as a result of an order by Lt. Gen. John C. Pemberton to conserve ammunition, Brig. Gen. Francis A. Shoup prohibited his men in the Stockade Redan sector from doing any promiscuous firing during the night. Unfortunately for the Rebels, this was the time the Union soldiers did most of their work.

By June 3, Ewing's Approach had been driven to within 150 yards of the redan. The soldiers of the 27th Louisiana and the 3d Missouri who were charged with the defense of that strong point were hard put to stop the Union progress. To make matters worse, they lacked any pyrotechnics with which to light the area in front of the works. In a futile effort to keep the Federals at bay, they threw up a line of rifle pits in front of the stockade. By adding a firing step, they converted the ditch into a trench. This work was accomplished under cover of darkness. As an emergency measure in case they were forced to evacuate the area, the Confederate engineers planted thunder barrels and loaded shells in the fortifications. Pemberton's Chief Engineer, Maj. Samuel H. Lockett, was in charge of these projects.

General Shoup was not overly enthusiastic with these stopgap measures. In a memorandum to his di-

[1]Grapevines were used for the wattling of gabions; cane for fascines. Layers of cane around two barrels, nailed together head to head, made a satisfactory sap roller which was impervious to Minié balls.

[2]Lt. Emmett Headington was in charge of the work on Ewing's Approach until May 31; Lt. Clemens C. Chaffee, Ordnance Corps, until June 19; and Capt. William Kossak, thereafter.



Ewing's Approach against Stockade Redan before Vicksburg, 1863

vision commander, Maj. Gen. Martin L. Smith, Shoup pointed out the advantages of a defense in depth. Smith apparently stuck his subordinate's recommendation into his pocket until June 12, when he learned that the head of Ewing's Approach had been pushed to within 20 yards of the counterscarp of Stockade Redan. He now ordered Shoup to go ahead, and work was started on a line of rifle pits across the base of the redan.

The only action that would have stopped the inexorable approach of the Union forces was a sortie. Shoup did not feel that his command was strong enough to undertake such a drastic step.

During the daylight hours, the Rebels found it almost certain suicide to stick their heads above the parapets. The Union snipers had added sandbagged loopholes reinforced by thick timbers to the rifle pits Blair's men had opened in May. The fire of these marksmen set fire to the cotton bales the Southerners had used to bolster their parapets, and the bales had to be removed.

Unlike the infantry, the artillery in Sherman's sector did most of its firing at night, inflicting considerable damage on earthworks and the log stockade. The only respite gained by the defenders was during and after the heavy rain which drenched them on June 10. For the next 36 hours, the Federals suspended their activities. But after this pause, they went back to work with renewed vigor. The thickness of the parapet prevented the gunners of the Appeal Arkansas Artillery from depressing their 12-pounder howitzer enough to register on the head of the sap.

On the morning of June 14, the Union cannoneers hammered the redan with a heavy bombardment. Besides damaging the parapet, they dismounted and disabled the howitzer. The Arkansans in the redan were then armed with grenades and thunder barrels, and under cover of darkness these daring men infiltrated the area between the lines. Grenades (6- and 12-pounder shells with short fuses) were lobbed into the Union saps. In this way, a number of casualties were inflicted on the Federals.

Of much greater effect was the fire of a 10-inch mortar which the Confederates moved from South Fort and emplaced on June 13 south of the Jackson road, in the sector held by Brig. Gen. John C. Moore's brigade. With this weapon, the skillful gunners dropped a number of 90-pound shells among the Union fatigue parties working on the approaches near the Graveyard road.

By June 17, the soldiers holding Stockade Redan and the Federal troops toiling away on Ewing's Approach were on speaking terms. The pickets at this point, known as the "trysting place," agreed to informal short truces. Besides exchanging notes, the men traded coffee for tobacco. Shoup prohibited these activities, but after dark, when the firing ceased, he found it impossible to enforce his edict. The harassed general relented to the extent of permitting relatives and friends in the opposing armies to exchange messages, their meetings to take place only in the presence of the officer of the day.

A furious shelling by the Union artillery on the morning of June 20 hammered the stockade. Shoup, inspecting the damage, said that the stout poplar logs used in the construction of the palisade were as sound as ever.

MINES AND COUNTERMINES

Daybreak on June 20 found the head of Ewing's approach within 20 feet of the counterscarp fronting Stockade Redan. The Federal engineers now found that the obstructions the Confederates had placed in front of the sap roller made it impossible to advance without exposing themselves to certain death. After crowning the sap roller with gabions and sandbags, the Union engineers left it in place; henceforth it would be used to afford protection to the pickets who were covering the fatigue parties.

Next, the sappers started digging two trenches—one branched off to the right, the other to the left from the head of the approach. They wanted to raise trench cavaliers parallel to the counterscarp of the redan. If they could do this, their infantry (with plunging fire) would be able to drive the Confederates out of the ditch fronting the redan.

To forestall the Federals, Shoup put his men to work sinking countermines.

The dull thudding sound made by the Rebels as they worked was audible to the Union sappers. Capt. William Kossak, who had been placed in charge of siege operations in the Graveyard road sector on June 19, interpreted the meaning of the sounds and put his men to work sinking counter-ditches, hoping to strike either the mine or its shaft.

After having bored holes to a depth of 10 feet and failed to intercept the Confederate mines, Kossak ordered the pioneers to sink two countermines—one to the right, the other to the left of the sap roller, starting in the cavaliers of the trenches. Although the Federals did not know it, the Rebels tried to spring their mine on June 24, but failed.

Forty-eight hours later (June 26), the Confederates beat the Federals to the punch. They detonated two mines near the head of Ewing's Approach.[3] The Rebel engineers had correctly calculated the amount of powder to use. The force of the explosions did not create a crater large enough to provide shelter for Union snipers, yet it was enough to fill in their countermines and pulverize the soil near the head of the sap. Any additional mining operations which Kossak might have been planning for that point were now impossible. The earth beneath the sap roller had been disintegrated; the sap roller settled to an appreciable degree. Since the sap roller continued to furnish protection to the Federals moving to and fro in the approach, it was allowed to remain in position. Except for the men who were shaken up and covered with earth and gabions from which they were pulled by their comrades, the Federals suffered no casualties in the explosion of the mines.

Concurrent with these developments, Kossak had put a number of men to work, throwing up several small traverses in the main approach. These traverses provided concealment and protection for his troops. After the traverse had been finished, Kossak had his engineers open a new sap. It veered off on the right, oblique from the principal approach.

CHANGE OF PLANS

Since the explosion of the mines had broken up the soil in front of the eastern face of the redan, Kossak had to change the direction of his approach. Also, he had learned from a Confederate deserter that the Rebels had a number of other mines charged and ready for firing. Kossak knew that if he were to place mines under the redan, his men would have to follow a circuitous route. An air of urgency was added to the situation by an order from Grant's headquarters on June 26. The general wanted Stockade Redan mined.

According to plans drawn up by Kossak, the sappers and miners from the 35th Missouri began work on the gallery. To conceal activities, the Federals located the entrance behind the traverses, near the head of Ewing's Approach. Since the mine was to be placed under the north face of the redan, the tunnel left the approach at a 45-degree angle. After tunneling about 60 feet, the miners found that their candles were being extinguished by the extreme heat and foulness of the air in the gallery. To overcome this, it was necessary to bore an air hole, after which work on the mine was resumed. After digging another 33 feet, the engineers reached the bottom of the ravine. The labor required to move the dirt from the mine in wheelbarrows was becoming increasingly arduous. Kossak had his men bore another hole to the surface. Fortune smiled on them: they broke through the ground behind a large log which concealed their activities from the Rebels. This exit provided a convenient place to dump dirt and gave additional ventilation.

Kossak calculated that the tunnel had now been extended beyond the area ruptured by the Confederate mines. He ordered his sappers to make a 90-degree turn to the left. Working day and night, in six-hour shifts, they had dug another 70 feet by the morning of July 4. The head of the gallery had been driven under the Graveyard road. During their stints in the cramped mine, the pioneers suffered greatly from heat and lack of air. The gallery was only 4 feet 6 inches high in the clear, 3 feet wide at the bottom, and 2 feet 6 inches at the top.

In a successful effort to prevent the Confederates from discovering the location of his gallery, Kossak instructed his sappers and miners to shove and push with their spades underneath the earth to be removed. He forbade the use of the pick, ax, or hammer underground, fearing that sounds from their use would reveal the location of the mine. Sandbags to be used for tamping the 2,200 pounds of black powder with which Kossak proposed to charge the mine, and 175 feet of powder had been prepared for the detonation when the news of the surrender of the Vicksburg garrison arrived.

[3] One of the mines was charged with 45 pounds of black powder, the other with 80 pounds. The mine chambers were 8 feet beneath the surface.

Amphibious Assault Bulk Fuel System

By WILLIAM W. LEWIS
Colonel, United States Marine Corps

TO TRANSPORT the oil from the first wells at Titusville, Pennsylvania, in 1859, some 2,000 boats were loaded with wooden barrels and floated down the Allegheny River on flood water. As more widely dispersed wells were dug some 6,000 wagons were used to transport the barrels of oil. In 1862 the first 2-inch pipeline was built, but was wrecked by the teamsters to save their jobs. About 1900 the steel drum was developed to replace the wooden barrel. The standard 55-gallon drum, the 5-gallon can, and a limited steel pipeline comprised the available equipment at the beginning of World War II.

In the European theater of war, pipelines were used more extensively than in the Pacific—mostly for long-distance transfer of fuels. In the amphibious operations in the Pacific theater and for unit delivery in Europe, the 55-gallon drum and the 5-gallon can were the standard containers for handling fuels. This entailed a tremendous expenditure of manpower and transportation facilities.

Since World War II the replacement of piston aircraft with jets and the addition of more fuel-burning equipment combined with the need for dispersion has necessitated a faster and more economical method of handling fuels. The combat fuel requirement for a fighter group has increased from approximately 60,000 gallons per day in World War II to some 200,000 gallons today. The 1,400 vehicles of a Division require about 54,000 gallons per day. Furthermore, the jet fuel JP-4 now used is far more dangerous and difficult to handle than gasoline.

It is estimated that the fuel requirements of future amphibious forces will represent approximately 60 percent, in weight and bulk, of all supplies required. For these reasons, it was obvious that in amphibious operations some more economical method had to be devised for moving large quantities of bulk fuels over the beach.

NEW SYSTEM

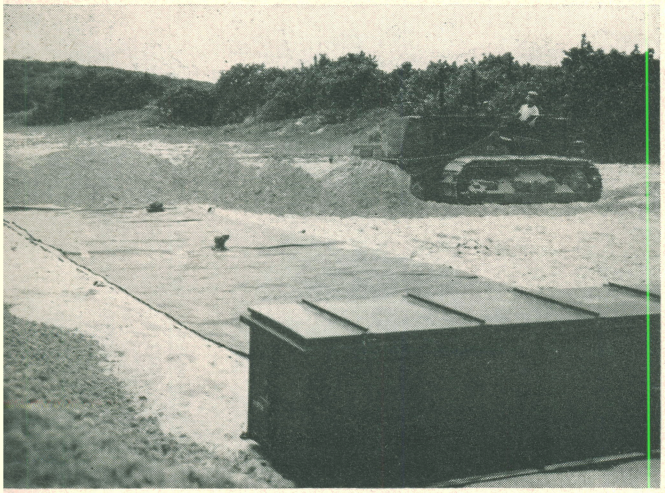
In 1949 studies were begun to develop a new system. The first tests of early schemes were followed by modifications, new contracts, and more testing. Gradually out of this development there emerged the first systems for field testing by the Fleet Marine Force. Concurrently with the development of the Amphibious Assault Fuel System (AAFS), the Tactical Airfield Dispensing System (TAFDS) was developed. The TAFDS uses the same components as the AAFS but does not have equipment for long-distance transfer or for receiving fuel in ship-to-shore transfer. The TAFDS is lighter and better suited for airlifting to an airfield site.

In order to realize the full capabilities of the AAFS an easily installed ship-to-shore transfer line was essential. The Navy developed a ship-to-shore floating hose which can be used with an anchorage as far as 6,000 feet offshore.

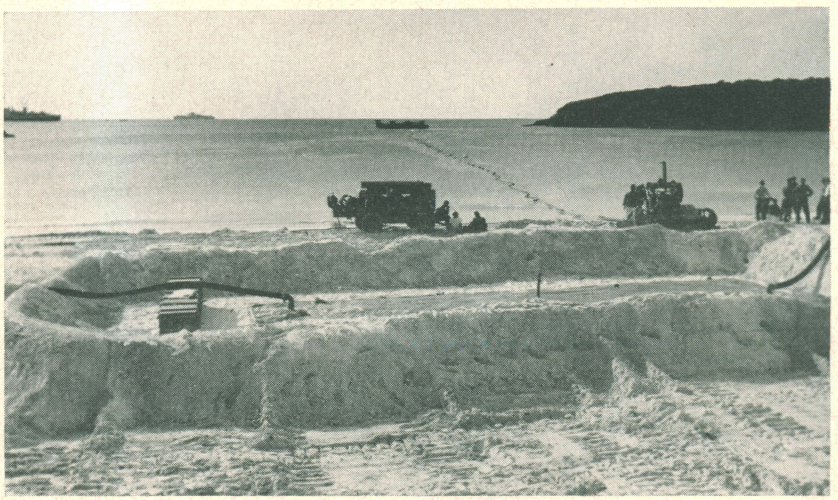
The AAFS is capable of receiving fuel at the beach from a ship-to-shore hose or pipeline or from shuttle craft and other vehicular carriers; furnishing equipment for installation in amphibious vehicles for shuttle delivery; transferring fuel from the beach to a tank farm inland; storing sufficient fuel to support operations; filtering and removing water from fuels; metering fuels dispersed; transferring fuels from the tank farm to the TAFDS or other systems; and dispensing fuels from the tank farm to delivery containers, vehicles, and other transporters.

The major components of the AAFS and the TAFDS are: collapsible neoprene tanks (10,000-gallon capacity for the main storage, and 900-gallon tanks for use in landing vehicles); rigid aluminum tanks (800-gallon capacity for use in landing vehicles); centrifugal self-priming pumps (rated at 350 gallons per minute at 275-foot head); transfer hose (25-foot non-

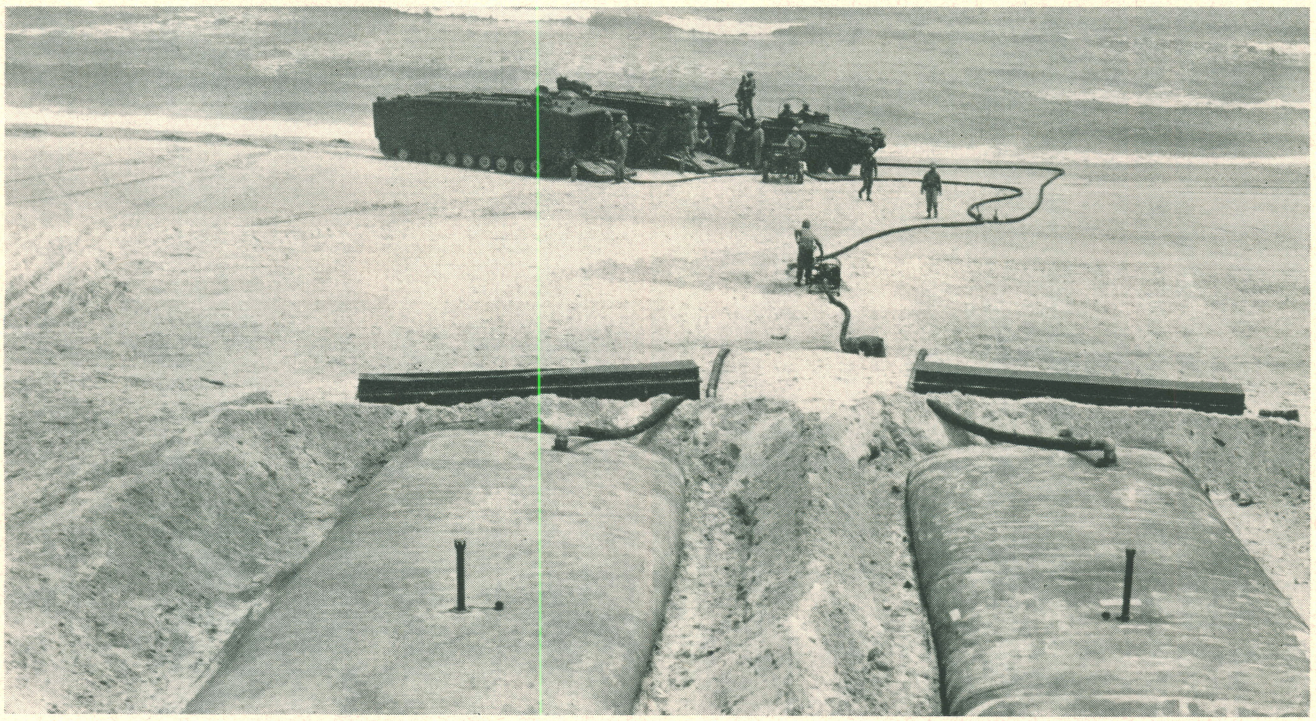
Truck Load of Bulk Fuel System Equipment Landing from LST



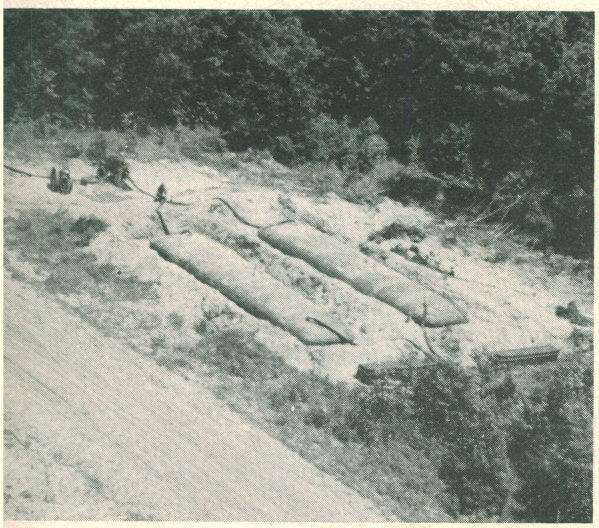
Bulldozing Berm around 10,000-gallon Tank



Tank Installation at Beach Unloading Station



Beach Unloading Station Receiving Fuel from Amphibious Vehicles



Pumping Station along Inland Line

Helicopter and Light Aircraft Being Refueled from System

collapsible suction and 50-foot collapsible pressure); and a water separator filter unit.

The AAFS system is made up into units consisting of a beach unloading station, a transfer hose line including five pumping stations (maximum of 3 miles in length), and a tank farm of five 60,000-gallon units (six 10,000-gallon tanks) totaling 300,000 gallons. The size of the tank farm can be increased in 60,000-gallon units to the size required. One TAFDS unit can store 60,000 gallons and can refuel six aircraft simultaneously at a combined flow rate of 675 gallons per minute.

OPERATION

Approximately 72 hours will be required for installation of the system after landing. During this period ground vehicles must depend, first, on fuel carried ashore in a prescribed load on vehicles, and, second, on fuels in 800- or 900-gallon tanks carried ashore in amphibian tractors, or in collapsible containers carried in by a helicopter.

After the AAFS has been installed, the beach unloading station can receive fuel from a tanker anchored offshore or from a beached LST, or, under more ideal conditions, from a docked tanker. The fuel is then pumped inland through the line at the rate of 350 gallons a minute. Pumping stations are located not more than 2,500 feet apart. The line is commonly known as a "broken system" in that one station pumps into tanks at the next station, and the next station pumps from this tank on to the next. This system utilizes low pressures, thus making it possible to use lightweight components, and allowing increased flexibility in operation.

At the end of the line leading inland the fuel is pumped into the tank farm, from which it may be pumped into the TAFDS or into vehicular transporters.

TRANSPORTERS

If the new development ended with the tank farms, fuel delivery to regiments and battalions would still be by the 55-gallon drum and 5-gallon can. To obviate this method, a mobile filling station for supplying forward units is being developed and special equipment for such a station is in use.

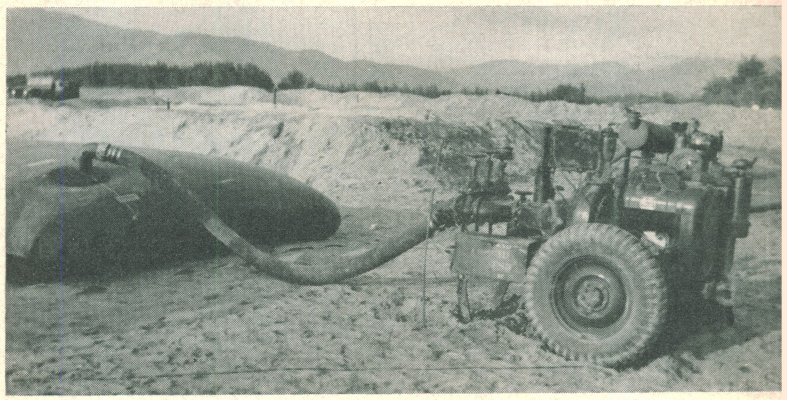
The 1,200-gallon tank truck is the standard means of distribution to units throughout the service area, but this vehicle cannot always reach forward units under combat conditions. A collapsible container called the "Sealdbin" has been developed for this purpose. It holds 500 gallons and can be transported by a light helicopter using an external sling, or by any vehicle of sufficient load-carrying capacity.

The rigid 800-gallon tanks (components of the AAFS), mounted in the Amphibian Tractor, may also be used to deliver fuels over rough terrain.

Another new device now being procured by the Army and under test by the Marine Corps is the Rolling Fluid Transporter, a two-wheeled unit, each wheel having a capacity of 500 gallons. The two container-wheels are mounted on a stub axle with a tow bar. The unit can be towed ashore by the amphibian tractor and a number of units can be towed in tandem when ashore.

INSTALLATION

The components of the AAFS are transported ashore in 4-wheel trailers and on towing trucks. The principal engineer work required for the installation consists of leveling the areas for the collapsible tanks and pushing up earth berms around each tank. On level terrain the pumping stations along the line leading inland would be set up approximately a half mile apart. On steep inclines this distance must be shorter if the pumping rate of 350 gallons per minute is to be maintained.



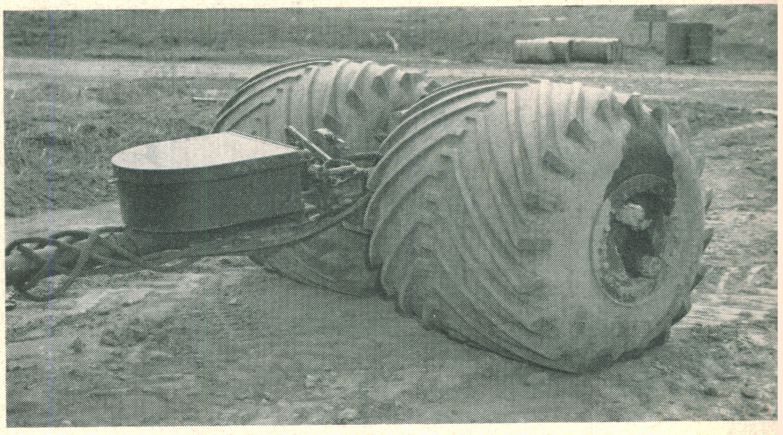
350-gpm Transfer Pump

The transfer hose along the line is laid out on the ground. No wrenches are required for the installation of the entire system. Although the installation is easy, protecting the hose against the tracked-vehicle driver is hard. This requires the preparation of crossover areas, marking the pipeline, and driver discipline.

This AAFS is controlled and operated in support of the ground and air units by the Bulk Fuel Company of the Automatic Supply Distribution Battalion of the Force Service Regiment. This company in peacetime is equipped with six 300,000-gallon bulk fuel systems. The TAFDS is carried by the Marine Air Groups.

The company can install and operate the six systems simultaneously in widely separated areas. It can combine the systems into one or more larger tank farms. This is a temporary system which should be replaced, when time and conditions permit, with more permanent facilities, so that it may be used again for the primary assault mission.

This is the system in the hands of the Fleet Marine Force today. Further improvements now in various development stages will simplify handling and add versatility and speed to the operation. However, the present system can furnish the support required in future amphibious operations.



1,000-gallon Rolling Fluid Transporter

XXth International Navigation Congress

By GEORGE H. KURTTILA

DELEGATES from thirty-seven countries, and observers from fifteen others, attending the XXth International Navigation Congress at Baltimore, Maryland, exchanged views on subjects ranging from economic justification for improvement of inland waterways to accommodation of nuclear-powered ships in maritime ports. This session, from September 11 to 19, 1961, was the second time in its 76-year history that the Permanent International Association of Navigation Congresses (PIANC) has met in the United States, the first time being in Philadelphia in 1912.

The membership of this organization includes government and port officials, representatives of firms and other interests, and individuals involved in planning, construction, and operation of inland and maritime waterways and ports. The Association, with headquarters at Brussels, Belgium, receives financial support from the various member governments. Its main purpose is the interchange of information on problems relating to ocean and inland navigation improvements. Quadrennial congresses, such as the one at Baltimore, provide opportunity for discussion of these problems and ways of solving them.

The President of the United States was High Patron of the XXth Congress. United States Senator John Marshall Butler of Maryland was president of the Congress and Maj. Gen. Charles G. Holle, United States Army (retired), was secretary general. Governor J. Millard Tawes of Maryland headed the American Organizing Committee, and Charles P. McCormick, board chairman of McCormick and Company, was deputy chairman. Valuable assistance was given by the International Secretariat from Brussels, headed by Prof. Gustave N. N. M. Willems, president of PIANC, and by the United States National Commission of PIANC, of which Maj. Gen. William F. Cassidy, United States Army, is chairman, and Col. Carl H. Bronn is secretary.

A highlight of the formal opening ceremonies at Shriver Hall, Johns Hopkins University, was an address by Secretary of State Dean Rusk. Conveying personal greetings from President Kennedy to some 750 delegates and their wives, Mr. Rusk noted the technical nature of the Congress and emphasized the need for efficient movement of goods and material resources and the assistance of countries just beginning their development to realize the full benefits of their inland waterways for commerce.

TECHNICAL SESSIONS

The technical sessions were conducted in two sections, meeting simultaneously: Section I, Inland Navigation, with Maj. Gen. John R. Hardin, United States Army (retired), serving as chairman, and Section II, Ocean Navigation, with Dr. Robert S. Rowe, Dean of Engineering at Vanderbilt University, as chairman.

In preparation for the Congress, 117 papers were submitted by authors from various countries, including ten from the United States. Summaries of the papers, covering eleven subjects in the inland and ocean categories, were presented for discussion at the sessions.[1]

Inland navigation topics included criteria for economic justification of waterway improvements; navigation engineering problems in multiple-purpose dam systems; measures to ensure day and night navigation; push-towing; and improvement of transportation on rivers of moderate size, including barges and other equipment, channel maintenance, and ways of solving difficulties in under-developed countries. Some of the many conclusions reached are: (a) in economic analyses of proposed waterways, consideration must be given to all effects of a proposed project, whether the effects are beneficial or adverse, or public or private, and to the most efficient use of all modes of transportation; (b) important waterways should include provisions for radar navigation; and (c) principal advantages of push-towing are the economy of manpower, efficiency in use of horsepower, and adaptability to inland waterways.

Ocean navigation topics included design and construction of terminals for large ships in exposed areas; orientation, layout, and improvement of access to seaports; measures for nuclear-powered ships in seaports; handling of wrecks; and methods of determining sand and silt movement, including use of modern techniques. Some of the conclusions were: (a) the Association should continue studies of economies in terminal design, wave action in harbors, and co-ordination of tanker and terminal design; (b) specific measures for reception and stay of nuclear-powered ships in ports will be needed; (c) economical means of minimum salvage protection should be found for countries with limited resources.

A subject considered common to both Sections included economic means of mooring ships on sloping or vertical banks; equipment for loading, unloading, and transshipment of cargo, and utilization of the same plant for different materials.

PROGRAM OF EVENTS

Besides the technical meetings, social functions and tours were held. Between technical sessions, delegates were taken on local tours of harbor facilities, the Chesapeake and Delaware Canal, Fort McHenry, and local industrial plants. Visits were also made to the Naval Academy at Annapolis, Washington, D. C., and Fort Belvoir.

At the conclusion of the Congress, each delegate had the option of participating in any of four post-congress tours: Port facilities in New York and vicinity; the St. Lawrence Seaway including Buffalo and Montreal Harbors; the Ohio River-Tennessee Valley; or the lower Mississippi Valley. Technical aspects of the tours were co-ordinated by local officials including officers of the Corps of Engineers. About 200 participated in these tours.

The many functions of the Congress afforded opportunity to exchange views on technical problems related to navigation on a world-wide basis, and contributed to promotion of international good will.

[1]The discussions and conclusions drawn from the papers will be published in Proceedings of the Congress.

Soldiers of Misfortune

By DAVID D. BARRETT
Colonel, United States Army, Retired

DULCE et decorum est, pro patria mori,[1] is fittingly said of those who perish for their fatherland. Honored almost as much are those who sacrifice themselves in fighting for a worthy cause in a country other than their own. No one, however, has ever had much to say in praise of the mercenary who dies for a country for which he has no love, and in a cause which to him means nothing.

Probably few mercenaries ever fought for a country for which they cared less, or in a cause in which they had less concern, than the White Russians who served in the army of the Chinese war lord, Chang Tsung-chang, in the years following the collapse, in Siberia, of the resistance to the forces of the Red Revolution. Few hired soldiers, moreover, ever faced death or wounds under worse conditions, or with less hope of material reward.

CONDITIONS AFTER WHITE RUSSIAN DEFEAT

The backbone of the resistance to the Russian Bolshevik Revolution was broken when forces of General Wrangel surrendered at Sebastopol in the Crimea on November 15, 1920. Following this defeat, about 130,000 defeated anti-Bolshevik troops and refugees were evacuated by the League of Nations to the Balkans and other parts of Europe.

Even after Wrangel's surrender, however, many anti-Bolshevik forces still remained in the field. The most important pocket of resistance centered around Vladivostok, where forces under Atamen Semenoff held out for another two years. In November of 1922, these forces in and around Vladivostok were no longer able to resist the pressure of the Bolsheviks, and all but a few of them crossed into Manchuria at Hunchun, a town in eastern Kirin Province, where the borders of the Maritime Province of Siberia, Korea, and Manchuria meet. Under an arrangement between the White Russians and Chang Tso-lin, the war lord then in control of the region that westerners call "Manchuria" but which is known to the Chinese as "The Northeast," the defeated troops were disarmed and placed in camps, where they were fed and sheltered at Chinese expense. After about a year, Chang Tso-lin wearied of this expense and allowed the White Russians to go wherever they pleased, as long as they did not look to him for logistical support. Many of these men drifted to Kirin, Harbin, and other cities on the Chinese Eastern Railway (particularly to Harbin where there was a large Russian colony). Others made their way south of the Great Wall to Tientsin, Shanghai, and other cities.

Naturally, many of the Russians turned out of the camps found it hard to make a living. Some of them had been fighting almost continuously since 1914, and knew no way of supporting themselves in civil life. To such men, any chance to earn food, clothing, shelter, and possibly some pay by serving as the hirelings of a Chinese war lord had a strong appeal. Such an opportunity was presented in 1923 when General Nechaeff, a former Czarist officer who had entered the service of Chang Tso-lin, began to recruit White Russians for the Chinese Army.

Chang Tso-lin, War Lord of Manchuria

THE WAR LORDS

In 1923, the Chinese Republic, established after the revolution of 1911 which overthrew the Ching, or Manchu Dynasty, was a political entity in name alone. Actual control of the country had passed into the hands of powerful war lords, each of whom had seized as much territory as he could and continually sought to increase the size of his holdings by fighting with other war lords. The "war lord wars" were utterly without significance except as struggles for power among brutal, selfish military commanders prompted solely by greed and ambition. The sufferings brought on the Chinese people by these conflicts were bitter beyond description.

China outside the Great Wall was completely under the control of the small, mild-mannered, soft-spoken

[1] "It is a sweet and proper thing to die for one's country."

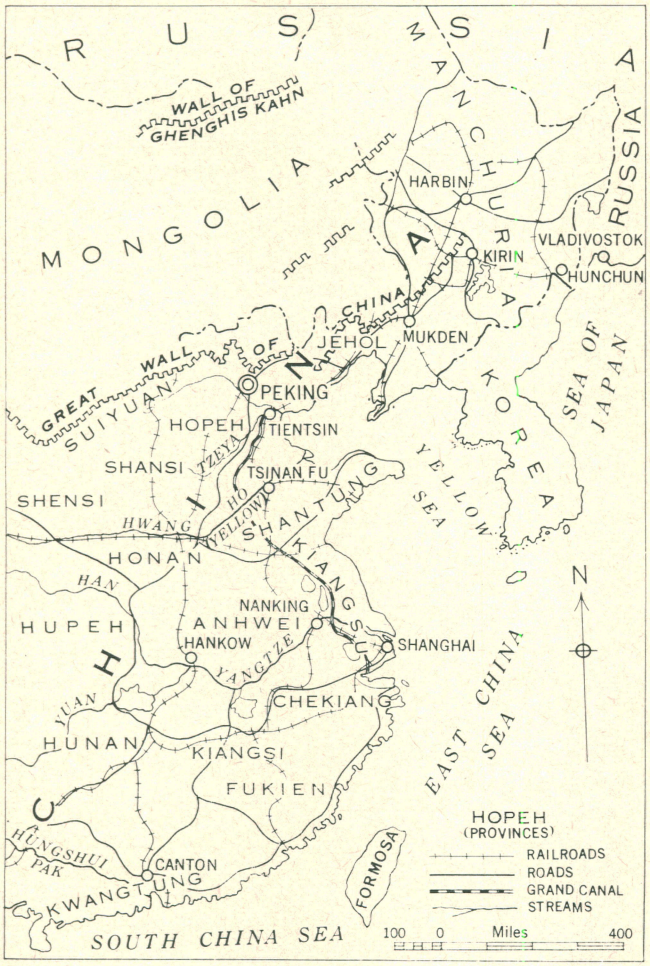
little war lord, Chang Tso-lin. Chang had been a *hung hutze,* or sort of Robin Hood, who had risen to power largely by co-operating with the Japanese in the Russo-Japanese war.

South of the Great Wall, in Shantung Province, the *Tupan,* or Military Governor, was a huge, uncouth ex-dock hand named Chang Tsung-chang. Chang had begun his military career as an enlisted man, and after rising to command of troops had served in the Northeast under Chang Tso-lin. In 1922, he had been appointed Occupation Commissioner, a high-sounding name for military boss, of an area in Kirin Province. Later, through some quirks of fortune he had come into control of Shantung, still as a subordinate of the Manchurian over war lord.

Chang Tsung-chang was a colorful figure. In his way of life he was anything but austere. One of his nicknames was "Three Things Not Know"—how much money he had, how many soldiers he had, and how many concubines he had.

While serving in Manchuria, Chang had acquired as an advisor a big White Russian named Merkuloff. Merkuloff was considered by some people a thief and a grafter, but he was smart, particularly in the way of feathering his own nest while promoting many enterprises, such as arsenals and uniform factories, for the *Tupan.*

In 1923, Merkuloff convinced Chang Tsung-chang that the defeated White Russians wandering about Manchuria would make good soldiers in his forces, which at that time were about to come into conflict with the army of Feng Yü-hsiang, long known as "The Christian General."



East China

Feng had not only joined the Methodist Church but was so anxious for his troops to embrace the Christian faith that he sometimes baptized regiments at a time with a fire hose. Whether Feng was a sincere Christian may be open to question, but he was not a bad general as war lords went in those days. His troops were well disciplined, and they treated the people far better than most of the Chinese soldiers of that time.

Acting on Merkuloff's suggestion Chang Tsung-chang began recruiting White Russians in 1923. The prospect of being able to eat at least fairly regularly must have had a strong appeal, for by June 1926, about 4,600 Russians had joined up. At that time they were organized into the Infantry Brigade, about 3,000 strong, under General Nechaeff: four armored trains, with a total personnel of about 1,000; a cavalry troop of about 100 who acted as Chang's personal bodyguard; and around 500 students in a military academy operated by the *Tupan* in Tsinanfu.

The Infantry Brigade and the armored trains gave an excellent account of themselves in the spring and summer of 1926 in the fighting between Chang Tsung-chang and Feng Yü-hsiang in the vicinity of Nankow Pass, about 80 miles northwest of Peking, and contributed to the crushing defeat of the Christian General. The personnel of the brigade and the armored trains suffered heavy casualties in this fighting. Russian losses were particularly heavy in proportion to their numbers, as they recklessly exposed themselves in action. Their wounded were miserably cared for, as was the case with all Chinese soldiers at the time. Any Russians who fell into the hands of the enemy were immediately shot or beheaded.

There were six armored trains in the forces of the northern war lords, of which four were directly under Chang Tsung-chang. It appeared that Chang Tso-lin had one for his personal use, and another was under the control of Chu Yi-pu, a subordinate of Chang Tso-lin who ruled the province of Chihli, later renamed Hopei. As I remember, "Honan," "Shantung," and "Peking" were three of Chang Tsung-chang's trains, and the fourth was the "Great Wall." Chu Yi-pu's train was the "Chihli," and there was a sixth train, the "Orel," named after a river in Russia, which may have been Chang Tso-lin's personal train.

THE NORTHERN EXPEDITION

With the determination to put an end to the senseless battles of the war lords by destroying the power of the rascals who were causing them, Chiang Kai-shek, then a military subordinate of the "Father of the Chinese Revolution," Doctor Sun Yat-sen, moved north from Canton with his forces in the summer of 1926 in what was called "The Northern Expedition." His objective was to capture the nominal seat of Chinese government, Peking, and unify the nation under a regime exercising real authority over the country and the people. Chiang had first come into prominence as the head of the famous Whampoa Military Academy in Canton, and many of his officers were graduates of that institution.

When the Northern Expedition was getting under way, I was an Attache for Language Study in the

American Legation in Peking. At the time it seemed to me highly improbable that Chiang's comparatively small force could fight, or buy (many battles were won in China in those days with "silver bullets") its way across the 900 miles of territory between Canton and Peking, much of which was occupied by the large, fairly well-equipped war lord armies which could be expected to put up stiff resistance.

The forces of Chiang Kai-shek's Northern Expedition were successful and had taken Shanghai and Nanking by March 1927. They then attempted to continue the advance north by moving up the Tientsin-Pukow and Peking-Hankow Railway lines. They encountered strong opposition, and in the summer of that year suffered severe reverses. In this fighting, the war lords' armored trains manned by the Russians again gave an excellent account of themselves and again suffered heavy casualties. Three armored trains which had previously been captured by Chiang Kai-shek's forces were retaken.

MILITARY TACTICS ON TRACKS

As was to be expected, since the trains could move only on railway tracks, their tactics were simple. Their principal use was to support infantry advancing in force on a wide front. The trains, with the infantry units disposed on both sides, would move slowly forward with the foot troops, blasting away at the enemy with field guns, mortars, and machine guns.

Liaison between the trains and the infantry was not always well maintained, and sometimes the fire of the former fell on the troops they were supposed to support. Even more serious, especially for the trains, was the danger of the infantry advance being stopped or driven back, so that the enemy could get behind the trains and tear up the tracks. When this happened it was then up to the Russians to fight their way to the rear, repairing the tracks as they went. They knew what would happen to them if they were captured.

Materials for the construction of the armored trains were obtained by the simple process of taking them from the Chinese railways, most of which had been built and the rolling stock purchased with foreign capital. The make-up of all the trains was in general the same. At each end was a flat car, loaded with ties and rails for repair of the line. The flats were also supposed to detonate any mines placed on the track to prevent damage to more important parts of the trains. Behind the flat on the front end came the heavily armored locomotive. The principal weapons of the train, 75's and machine guns, were mounted in turrets placed in open steel gondolas. Trench mortars were also carried, but they were usually fired from the ground, or from the open parts of the gondolas.

In the center of the train were the combined headquarters and officers' quarters, usually one of the coaches of the crack Blue Express which operated in peacetime between Peking and Pukow, on the Yangtze River. The enlisted men were housed in a box car, sometimes armored, sometimes not, fitted with bunks. Thus the train was simply a moving fort, a sort of gunboat on wheels. Against forces armed with modern artillery, or supported by airplanes, they would not have lasted an hour.

I had seen the trains when they would occasionally pull into the Peking railway yards, during operations on the Nankow front. I was eager to ride one, and see it in action. My chance came in the spring of 1928

Area of Operations around Tsinan

when Chiang's forces, after their reverse of the year before, were again moving north and had reached southern Shantung. Chang Tsung-chang's troops were then falling back, offering little resistance to the advance of the Northern Expedition.

MILITARY OBSERVER

At this time the Military Attache of the American Legation in Peking sent me to Shantung to observe the military situation. I succeeded in reaching Tsangchow, south of Tsinan, but could get no farther as no passenger trains were running beyond that point. While in Tsangchow I visited the railway yards daily to observe units passing through and pick up what information I could concerning the situation at the "front," meaning the area in which forces of Chang Tsung-chang and Chiang Kai-shek were more or less in contact.

One day while walking around the yards, I saw the armored train "Peking," with steam up, on a siding and apparently about to move south. A Russian in the uniform of a major in the Chinese army was standing in the vestibule of a coach near the front of the train. From the major I learned that the train was going to Lincheng, an important town at the "front," near the Shantung-Kiangsu border, which had just been occupied by Chiang-Kai-shek's forces. The major allowed me to board the train and a few moments later it headed south.

The major, who proved to be second-in-command of the train, introduced me to the other officers, who seemed not in the least astonished that a captain in the United States Army should be riding toward the front with them. One or two of the officers spoke a little English, some spoke German, and one, the official train interpreter, who had been born in China, spoke Chinese fluently, so we had little difficulty in making ourselves mutually understood. I was as-

signed a compartment in the part of the coach used as officers' quarters.

There were about ten officers on the train, which was commanded by a lieutenant colonel. Some of the officers bore scars of wounds received in action in World War I, or in fighting in China. All treated me with the utmost courtesy, and I soon felt at home among them.

As we rolled south, we encountered large numbers of Chang Tsung-chang's retreating soldiers making their way north along the railway line. These men were mostly disorganized, and evidently without logistical support, for they looked tired, ragged, and hungry. Chang Tsung-chang had long been noted as a poor administrator, surrounded by a venal and inefficient staff, and here was proof of it.

That evening we arrived a short distance north of Lincheng, where we could see troop trains of Chiang Kai-shek's forces at the railway station. Our train fired two rounds from a 75mm gun, and a moment later steamed back toward the north. It would have been foolish to remain near Lincheng as we had no supporting infantry.

I stayed on the train four or five days, during most of which we sat on sidings between Lincheng and Tsangchow. Once an enemy cavalry patrol moving along a road parallel to the railway at a distance of about 600 yards was spied and fired on with a machine gun, but with no visible effect. At another time while we were sitting on a siding, an enemy patrol got behind us and tore up a few yards of track. We steamed to the spot at once. Without even making use of the ties and rails carried on the train, the Russians speedily repaired the break. Evidently, they had had long experience in this sort of work, to which they turned with a will.

Most of the enlisted men of the "Peking" were young Russians, some apparently only in their teens (which meant they had never fought outside of China). Officers and men received the pay corresponding to the same ranks in the Chinese army: the privates the equivalent of about $3, field officers about $30 or $40 a month. Their pay was usually at least a month behind, as it was customary in the Chinese army for the commander to be given the pay of his unit in a lump sum for him to distribute. Often he kept this pay for a while in order to lend it out at interest or engage in speculation.

Guard mount was held every day at noon. At the close of the simple ceremony, both old and new guards took off their caps, held them over their hearts, and sang, very beautifully, a Russian hymn. It was moving to see these stateless mercenaries, serving in the heart of an alien country for which they cared nothing, and which cared even less for them, carrying on a tradition which had ceased to exist in a homeland which many of them had never seen, and none of them, in all probability, would ever see again.

On the "Peking" the only Chinese were the engine crew, two cooks, and one or two "boys." The food was simple but satisfying, consisting mostly of stew, rice, and one or two vegetables probably obtained by foraging in the countryside. Tea was available all day long in the officers' car, and vodka before dinner.

One of Chang Tsung-chang's irregular pay days came while I was on the train. An officer and several enlisted men immediately boarded one of the few passenger trains still running and headed for Tsinan. Next day the detail returned, loaded with supplies of food and drink, even including caviar, wine, and whiskey. That night we had a "gala" dinner in the officers' mess.

While on the train I observed no attempt at training, not even close order drill.

At the time I rode the armored train, it was naturally of limited tactical use. Had the withdrawal of Chang's forces to the north been executed in an orderly manner, the train might have been able to provide some cover. With the retreating soldiers strung out for such a long distance, however, any fire from the train might have fallen on them instead of the enemy. There was, in fact, little contact between Chiang Kai-shek's forces and those of Chang Tsung-chang as they fell back. A well-organized pursuit could have destroyed a large part of the latter, but none was carried out. It behooved the train to keep well ahead of the retreating forces, otherwise it could easily have been cut off.

I was among those who stood on Legation Street, Peking, in the summer of 1928 and watched the first contingents of Chiang's forces march in to take over the Ancient Capital. The first objective of the Northern Expedition had thus been attained by the occupation of Peking, although much fighting still lay ahead for Chiang Kai-shek before China could be called unified. Among the troubles in store for him was the as yet undreamed-of rise to power of the Chinese Communists.[2]

EPILOGUE

After the capture of Peking by Chiang, most of the war lord armies south of the great wall melted away. Some units under Feng Yü-hsiang and Yen Hsi-shan, war lord of Chansi, still remained in the field and gave Chiang a hard fight before they were finally defeated a year or so later.

In the Northeast, Chang Tso-lin died at the hands of the Japanese, who blew up an armored train, with him on board, near Mukden in July 1928. The Japanese had no use for him then, and did not hesitate to put him out of the way.

Chang Tsung-chang, with no troops to command, but with possibly some money left from the millions he once possessed, lived on for a year or so after Chiang Kai-shek won control of North China. In 1930, while standing on the station platform in Tsinan, he was shot by a woman whose husband he had put to death. "Those who live by the sword shall perish by the sword."

Merkuloff, at one time a millionaire, lost everything with the fall of Chang Tsung-chang. He eventually died in poverty in Harbin.

Some of the White Russians succeeded in making their way to Harbin and Shanghai, where there were big Russian colonies and they stood some chance of earning a living. Many of the wounded, sick, and crippled were left to beg in the streets until they died of starvation or disease.

Thus, "unwept, unhonored, and unsung," passed into the limbo of forgotten things a band of unfortunate mercenaries whose effect on the course of history was even less than that made by the Hessians who fought for George III in the American Revolutionary War.

[2]Destined, 20 years later, to drive him from the mainland of China.

Field Profiles Mechanically Plotted to Scale

By WALTER C. CAREY
Lieutenant Colonel, Corps of Engineers Reserve

MODIFICATIONS to two items of hydrographic surveying equipment, the echo depth sounder and the distance-wire measuring-wheel, make it possible to produce field cross sections or profiles ready for use without further plotting; they are true to scale in both directions with automatic "fixes" at 100-foot intervals.

EQUIPMENT

The equipment required for hydrographic surveying, as contemplated, includes a seaworthy survey boat carrying conventional equipment and, in addition, a distance-wire measuring-wheel, an echo depth sounder, and the electrical equipment and mechanical parts to tie together the depth-sounder paper-feed drive and the distance-wire measuring-wheel.[1]

Distance-wire Measuring-wheel. This device has a long history in the New Orleans Army Engineer District. Before 1900, the "sounding machine" had been developed by Assistant Engineer Wooley. It consisted of a steel framework in which two wheels fitted with ball bearings were vertically mounted. The first wheels were actually obtained from bicycles of that day. One wheel was the "distance" wheel. On its rim was wound a length of piano wire which was used to measure the distance from a known point on range, when engaged in sounding ranges, or to pay off the swinging radius, when the machine was used to cover an area by "circle-sounding." The other wheel was the "sounding" wheel. The piano wire wound on its rim was used to suspend the sounding lead and to measure the depth of water. Each wheel had a worm gear connected so as to drive a horizontal circular brass plate, graduated to read distances or depths. Both wheels could be "set." Thus, the distance wheel could read total distance from the base line, and the sounding wheel could read depths referred to "mean low water" or other reference plane.

The sounding skiff on which this machine was mounted was originally propelled by three husky oarsmen, the actual operating technique depending upon whether ranges were being sounded or an area was being covered by the circle-sounding method. Compared with any other method of hydrographic surveying, the machine was faster and more accurate, both as to soundings and their horizontal locations. The key to this accuracy was the slight resistance to the current offered by the piano wire suspending the lead.

The first improvement, after some years of use, was the substitution of a gasoline engine for the oarsmen. This speeded up both types of operations. The next improvement was the use of a mechanical counter ("Productimeter") for indicating soundings and distances.

[1]Designed and constructed by Will S. Talbot, Chief, Radio Communications Section, New Orleans Army Engineer District, who assisted in preparing this paper.

The final development, the distance-wire measuring-wheel (Figure 1) resulted from attempts to sound cross-river ranges involving distances up to 4,000 feet on the Mississippi River. Prior to this development the operating range of the distance-wire wheel had been about 1,000 feet. The associated practical problem of keeping the distance-wire out of the swift cross current was also solved by applying constant tension to the wire as paid out, and by leading it out of a "fair-leader" at a considerable height above the water, so that it would lead fair at all times, regardless of the angle of lead with respect to the boat.[2]

The distance-wire passes around the rim of the accurately machined wheel and, as the wire is paid out, it rotates the wheel. The wheel shaft, in turn, actuates a mechanical counter which indicates the distance. The wire is not stored on this measuring-wheel, but simply passes around it as the sounding boat moves out from the fixed point on range on shore. The distance-wire measuring-wheel is now used for distances up to 40,000 feet. An accuracy of better than 1 in 1,000 is readily possible. This device fills a definite hydrographic surveying need, within its scope of operation, more efficiently than any other device or method. It would easily lend itself to operating by radar guidance under bad working conditions.

The Echo Depth Sounder. Although it is believed that any ultrasonic sounder can be modified as here

[2]Music wire is used, .029 inch diameter, 333,000-363,000 tensile, 36,000 feet on a spool.

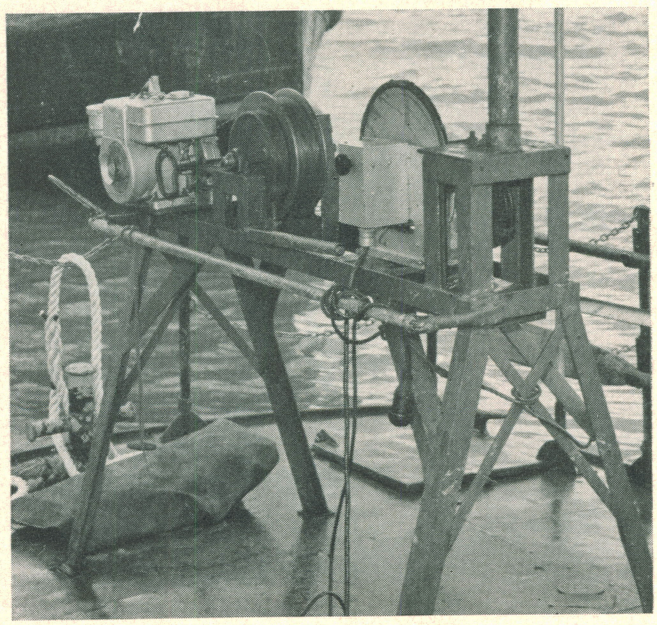


Figure 1. The Distance-wire Measuring-wheel

On the stand, l to r: Gasoline motor drive, wire storage wheel, distance-wire measuring-wheel, and sheave and vertical pipe leading to "fair-leader" at top.

described, the particular machine employed was the Bludworth Marine ES-130 portable precision depth sounder (Figure 2). A principal reason for its selection was that the vertical co-ordinate graduations are straight instead of curved as in some echo depth sounders. Curved vertical co-ordinate lines entail distortion that is objectionable when the cross sections are to be used in determining areas.

Paper-feed Drive Connector. To produce field cross sections or profiles true to scale in both directions, the paper movement must be proportional to horizontal distance moved, rather than proportional to the elapsed time. This could be achieved by interconnecting the paper-feed drive with the distance-wire measuring-wheel. Three solutions were considered: (1) Mechanical, by chain or gear combinations. This appeared to be entirely feasible. (2) Hydraulic, wherein a hydraulic pump, actuated by the distance-wire measuring-wheel shaft, drives the hydraulic motor that actuates the paper-feed drive mechanism. This seemed feasible in view of the high state of development of hydraulic mechanisms (for various functions on airplanes, for example). (3) Electrical, wherein a synchro-type generator, driven by the distance-wire measuring-wheel shaft, drives a so-called "slave" motor, with similar characteristics, which in turn drives the paper-feed drive mechanism. Electrical drive was selected because it seemed to be the simplest. The results appear to justify that decision.

For this application, the echo depth sounder was fitted with a synchro-motor system for the paper-feed drive (using Navy Ordnance Size 1 synchros). The synchro generator (Figure 3) was direct-coupled to the shaft of the distance-wire measuring-wheel through a one-way positive clutch drive. A ratchet gear and pawl prevents the synchro generator from rotating backwards when retrieving the distance wire. The synchro motor with 100-to-1 right-angle speed reducer was mounted on the underside of the hinged recorder unit directly under the paper-feed drive shaft and coupled to it by a one-way right-hand positive clutch drive. Because of the low torque requirement of the paper-feed drive mechanism, this direct "back-to-back" synchro system has operated satisfactorily for experimental use. For permanent use, it would be desirable to employ smaller synchros in conjunction with a servo system, and thus provide a more compact unit. A seven-conductor plug-in cable provides all electrical connections between the distance-wire measuring-wheel and the recorder unit. Figure 4 shows the survey boat with equipment installed.

The modification does not interfere with the normal designed use of the echo sounder, and changing from the designed time-controlled operation to the distance-wire-controlled operation requires only the switching of the 115-volt, 60-cycle, a-c power to the latter's electric drive system and engaging the drive mechanism to the paper-feed roller. A lock-out device holds the normal paper-feed drive system in neutral when the synchro-motor drive system is in use.

OPERATIONS

Automatic Fixes at 100-foot Intervals. An attachment was provided that makes fixes for each 100 feet of distance traveled. For this a micro-switch was incorporated into the distance-wheel's productimeter-type digital counter, thus making the recording of the fixes entirely automatic. A vertical line is scribed electrically on the chart at precisely equal intervals. Fixes made in this manner are far superior to manual or visual means for cutting-in fixes. The vertical lines on the graph provide a ready basis for adjusting the planimeter when measuring areas or for making allowances for distortion of the paper.

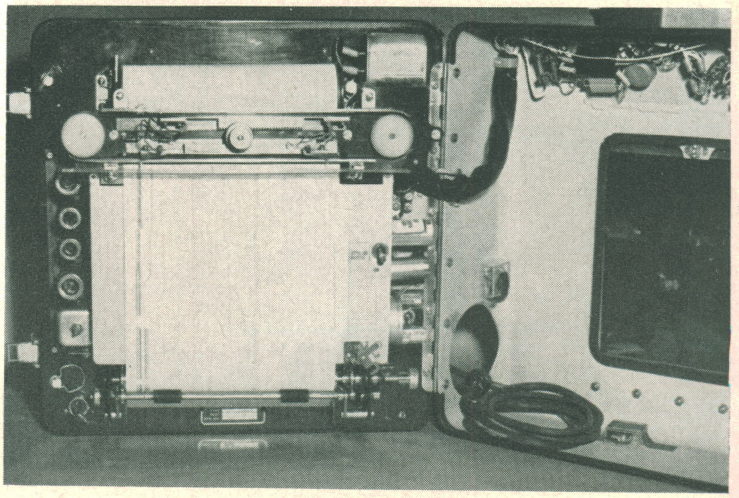


Figure 2. Front View of Depth Sounder
Note stylus motor on-off switch, switch for selecting synchro motor or normal paper-feed drive and, lower right corner, toggle for holding gears.

Changing the Horizontal Scale. The vertical scale, of 9 feet to the inch, is fixed by the design of the echo depth sounder and is not subject to change. The horizontal scale for this application is nominally 100 feet to the inch (actually 100 feet to .958 inch). This scale should be susceptible to change by some future development. One possible means is the use of a different diameter of distance-wire measuring-wheel for each scale. Another method would be to include several sets of gears and a gearshift arrangement.

In considering the changing of the horizontal scale it must be kept in mind that the slower the paper speed the darker or more dense the graph. The reason for this is that at slow paper speeds a number of individual pulse recordings are superimposed on each other, resulting in a dark graph. As the paper speed is increased, the graph becomes lighter, until finally each pulse recording shows up separately, with an actual space between individual pulse recordings.

In order to increase the density of the graph at faster paper speeds (or larger scales) one or more of the following expedients must be used: (1) increase the power of the transmitted pulse, (2) increase the pulse repetition rate, (3) increase the pulse length, or (4) slow down the sounding boat. The graph will, of course, be denser when sounding in shallower depths of water. The technical basis for these points is that the maximum pulse repetition rate depends on the maximum depth of sounding. The machine used in the experiment was designed to sound to a depth of 240 feet. Since the average speed of sound in water is 4,800 fps, it requires 100 milliseconds for sound to travel the 480-foot round trip from the surface to the bottom and back to the surface. The maximum pulse repetition rate, when sounding to a depth of 240 feet, is 600 pulses per minute. The maximum designed paper speed for the ES-130 machine is 4 inches per minute, which gives 150 pulse recordings per inch of chart paper.

In modifying this machine, these facts were con-

sidered in the light of the following operating data: A survey boat, sounding a range at a normal speed of 5 mph, travels 440 feet in one minute; at a paper advance rate of 0.958 inch per 100 feet, this amounts to a paper advance rate of 4.2 inches per minute; at 600 pulses per minute, this gives 143 pulse recordings per inch of chart paper, or about the same number per inch as when the machine is used for its designed paper speed of 4 inches per minute. This points to the conclusion that a paper speed of 5 inches per minute, with 120 pulse recordings per inch, is the maximum unless some sacrifice in graph density is accepted. With depths less than the maximum, the absolute limit, for usable results, appears to be 60 pulse recordings per inch, or a scale of 1 in 600 (50 feet to the inch). Smaller scales, of course, offer no problem.

USES OF THE RECORDINGS

The resulting cross sections or profiles may be used by visual examination for whatever purposes this may serve.

Comparisons of cross sections with previous ones on the same ranges may be made to note the nature and extent of changes, such as scour or fill. For this purpose, an electrostatic reproduction on translucent vellum could be compared with a similar reproduction from an earlier survey by winding both rolls in register through a suitable device including a light table.

By observing certain precautions, depending upon the basis for pay quantities, these cross sections could be used to determine dredging quantities. A translucent print of cross sections before dredging could be superimposed on a similar print after dredging and a tracing made to provide cross sections for planimetering cut areas. Possibly the "tracing" could be done photographically.

Such profiles could be used for reservoir sedimentation studies. Again, two prints, taken at different times, could be wound through in approximate register and changes noted or planimetered.

For certain uses, the depth-sounder rolls could be microfilmed, and the microfilms used in a viewer.

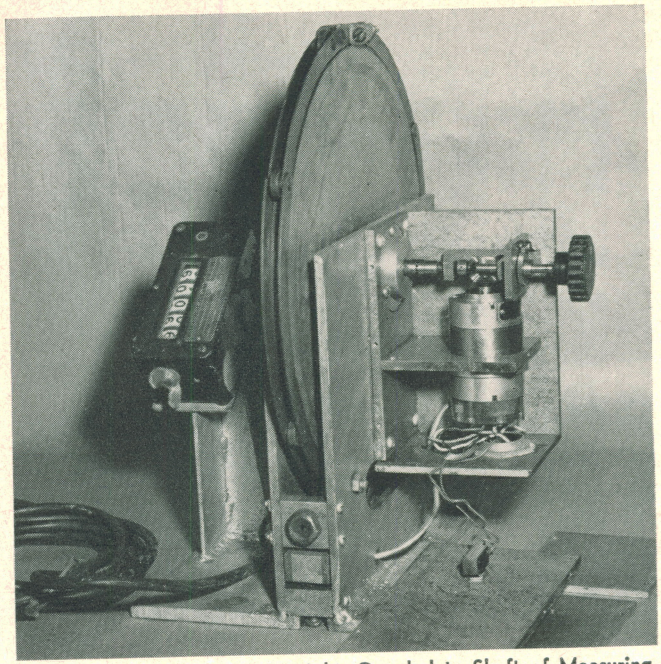


Figure 3. Synchro Generator, right, Coupled to Shaft of Measuring-wheel

Tabulations could be made as the film is moved through the viewer. It would seem to be possible to project two such films in register simultaneously on the viewer screen. For these uses, the microfilms will be the end product; hence, the originals can be destroyed, making substantial reduction in filing space requirements.

It is concluded that, by the use of this equipment, it will be possible for the various water resources agencies to speed up field work, reduce field costs, and reduce time and costs of the office work in preparing quantity estimates or other data for studies and reports. As an incidental result, accuracy will be improved due to more accurate longitudinal distances and the preservation of the original detail of the field cross sections or profiles.

Figure 4. The Survey Boat. Note Equipment and Fair-leader at Top

Radioprotectant Drugs

By JACK DE MENT

RADIOPROTECTANTS, or antiradiation drugs, are substances which, when introduced into the living system, enable that system to survive an otherwise maiming or killing dose of radiation received shortly thereafter. The ideal radioprotectant is one that, within a reasonable time limit, could be taken after exposure. At present, an ideal radioprotectant seems highly unlikely any time soon.

Large-scale studies are underway at the Walter Reed Army Research Institute and at the Air Force Radiation Laboratory to find radioprotectants for human use. This important effort deserves the highest priority.

NUMEROUS USES

In medicine such drugs would be extremely valuable as they would enable a patient to absorb a larger therapeutic or diagnostic dose of radiation. In isotopology such a substance would allow the use of increased amounts of radioisotopes in living systems. Also, isotopes which cannot now be employed because of short half-life might be used in massive quantities to compensate for short half-life. Ion-beam surgery and neutron-capture therapy would also feel the benefit of a suitable radioprotectant. In the field of research, activation analysis in living organisms and the ability to trace routes and pathways by radioisotopes in physical processes would take on new meaning. It is also possible that a special class of radioprotectants could be developed which would have specificity, or lack of specificity, for neoplastic tissue, thus providing a new approach to the radiation treatment of cancer.

Radioprotectants would be important for people working with and around radiation, such as reactor operators, repairmen dealing with reactor accidents, and maintenance men who must contend with radioactive spills. For spacemen, the radioprotectant would help to solve the problem of overcoming the effects of space radiation.

The value of an antiradiation drug in wartime is obvious. Troops as well as civilians would be supplied with them for immediate use. They might even be given to animals that are raised for food. Such drugs might well provide the answer to radiation weapons.

Although radioprotectants suitable for human use are not now in existence, their application in experiments with mice has made it possible for these animals to survive twice the lethal dose of X-radiation.

ACTION AND EFFECTS

Some of the pharmacological aspects of radioprotectants have been investigated. The most effective antiradiation compounds under investigation contain sulfhydryl groups (SH). Two of the more potent which have been discovered are 2-aminoethyl-isothiourea dihydrobromide (AET) and mercaptoethylamine (MEA). Both compounds protect mice against a double dose of X-rays. In higher mammals, however, the results are not encouraging, and it is not known whether these substances exert a protective effect. Dogs and monkeys do not tolerate the large doses required. Man is no exception, tolerating them poorly. Local application, instead of systemic administration, has been claimed to afford some degree of local protection, but this is still questionable.

Controversy appears to exist over the action of sulfhydryl compounds in exerting their radioprotection. When living tissue is exposed to radiation it first absorbs the radiation; then the tissue water undergoes radiolysis, producing mainly hydrogen peroxide and free radicals. Certain molecular groups are particularly radiosensitive on proteins and enzymes, which become inactivated and result in biochemical lesions which, in time, cause cellular and tissue damage or death. Some workers feel that SH compounds act as "traps" to absorb peroxides and free radicals formed upon irradiation of tissue water, inactivating them and sparing vital biochemical systems. Other investigators hold to the "mixed disulfide theory"—that radioprotectants combine with protein sulfhydryl groups to form disulfides. When the disulfide bond is attacked by radiation-derived free radicals, the protein sulfhydryl is regenerated and the sulfhydryl of the protectant is oxidized, thereby neutralizing the free radicals.

Another theory is based on the fact that when oxygen is excluded from bacteria and enzymes, the effect of radiation is diminished. This is commonly known as the "oxygen effect." By lowering the tissue oxygen tension a small degree of protection can be obtained in mammals. The exclusion of oxygen lowers the yield of hydrogen peroxide and free radicals during the radiolysis of tissue water. Using the oxygen effect as an approach, certain vasoactive drugs which do not contain sulfhydryl offer possibilities as radioprotectants, although apparently they are not as promising as sulfhydryl compounds. Tryptamine and certain hydroxytryptamines (serotonin), histamine, and epinephrine, all of which are non-SH compounds, produce a potent vasostrictive effect and thus lower the oxygen tension, probably by restriction of oxygen to tissues, particularly the spleen and bone marrow.

Even when nuclear warfare becomes no longer a threat to life on earth, the need for radioprotectant drugs will increase as peacetime uses of nuclear energy multiply and expand. It is not unlikely that people will carry such an antiradiation drug at all times—perhaps calling it the "atomic aspirin."

Tunneling in Permafrost

By GEORGE K. SWINZOW

PERMAFROST may be defined as any soil material whose natural moisture is "permanently" frozen and thus cements the particles into a solid mass. One-fifth of the world's land area is underlaid by ground the temperature of which remains below the freezing point throughout the years.

The problems of excavation in permafrost are similar to those of excavation in hard rock. The use of steam or other types of thermal treatment for tunneling is uneconomical, but conventional methods such as drilling, blasting, and mucking have proved to be successful and practical.

During the summers of 1959 and 1960, experimental tunneling in permafrost has been conducted in the general area of Thule, Greenland.[1]

The soil in which the excavations were made was permanently frozen till (a mixed-grain soil) with a moisture content[2] up to 20 percent and a temperature of between 12 degrees and 32 degrees Fahrenheit.

UNIQUE EFFECTS

In comparison with hard-rock drilling, the operation in permafrost is easier although certain unique problems created by the low temperature had to be overcome. For example, water in the drilling fluid froze, making the machine inoperative. Addition of ethylene glycol antifreeze eliminated that difficulty.

Blasting with gelatin dynamites of medium velocities was most successful. (Strong explosives with high propagation velocities produced such a high spread of the muck pile that there were undesirable delays in the mucking operation.) Powder factors from 2.0 to 6.2 pounds per cubic yard could be obtained in the particular type of permafrost encountered. A procedure unique for permafrost was developed for the improvement of fragmentation. The charged holes were completely backfilled with a very moist silt and coarse sand mixture which was allowed to freeze in the holes. Since the backfill contained more moisture than the permafrost, the drill holes were completely sealed and the explosive acted entirely on the rock, having no relief such as that usually provided by the conventionally stemmed hole.

The removal of the fragmented frozen till (mucking) did not present any special problems.

TESTING FACILITIES

A total of 600 feet of tunnel was drilled and three experimental rooms were excavated. One room, assigned exclusively to the studies of heat dissipation in permafrost, was equipped with 86 thermocouples and regulated heaters to provide for the observation of conductivity values and moisture migration. Valuable data will be obtained on the changes in physical properties effected by altering the thermal environment.

Another room was used for general cold laboratory work such as ground ice crystallography. It was also equipped with a foundation for a seismograph.

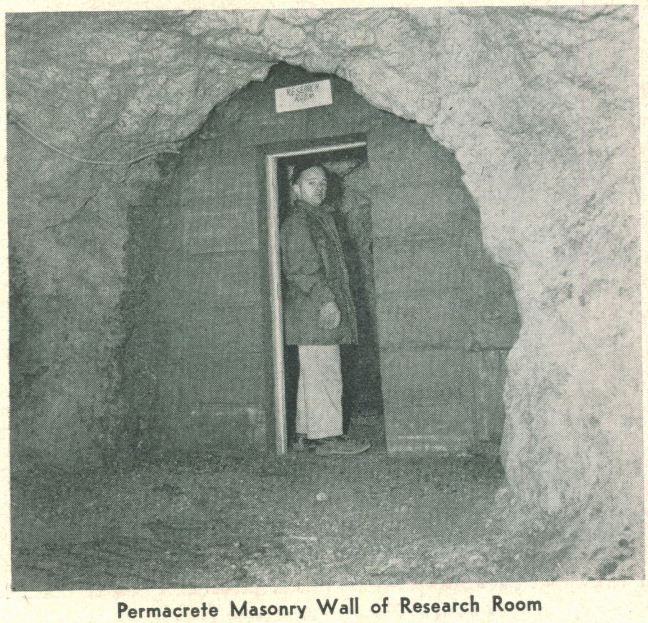
The third room will be used as a "permacrete" workshop in which studies will be conducted on the engineering properties and uses of an artificially frozen construction material.

The cold temperature was used to advantage during the mining operation for several engineering purposes: roof reinforcement was provided by spraying the permafrost with water until a coat of ice formed; and the adfreezing of rails[3] to the bed eliminated buckling and excess wear so that, once installed, rails became practically maintenance-free.

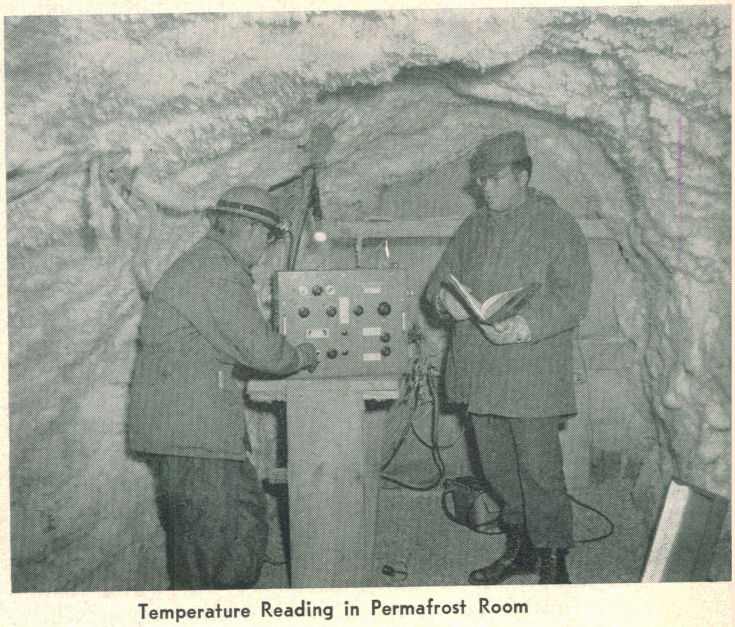
[1]By the Army Cold Regions Research and Engineering Laboratory, aided by the Army Polar Research and Development Center and the Army Engineer Research and Development Detachment.

[2]"Moisture content" is defined as the weight of water in a soil material expressed as a percentage of its dry weight.

[3]Of the narrow gauge railway.



Permacrete Masonry Wall of Research Room



Temperature Reading in Permafrost Room

Tunnel Section with Tracks Frozen to Bed

Permacrete Masonry Arch

Snow and ice tunnels have the disadvantage of being subject to continuous plastic deformation, so that any opening in snow or ice will close completely after a short time. A 7- by 8-foot tunnel excavated in the icecap several years ago in the Thule area has been completely closed by the plastic deformation of the ice. Permafrost, on the other hand, does not deform plastically since the frozen soil particles are usually in contact with one another and the ice is the cement which holds the material together. For this reason, old diggings in the permafrost in Alaska are still accessible.

Loss of moisture from the walls of a permafrost tunnel is undesirable, since this is the cementing material which holds the aggregate together. Fortunately, after excavation a thick layer of hoarfrost forms on the surface of the newly exposed permafrost, and prevents loss of moisture by sublimation.

PERMACRETE

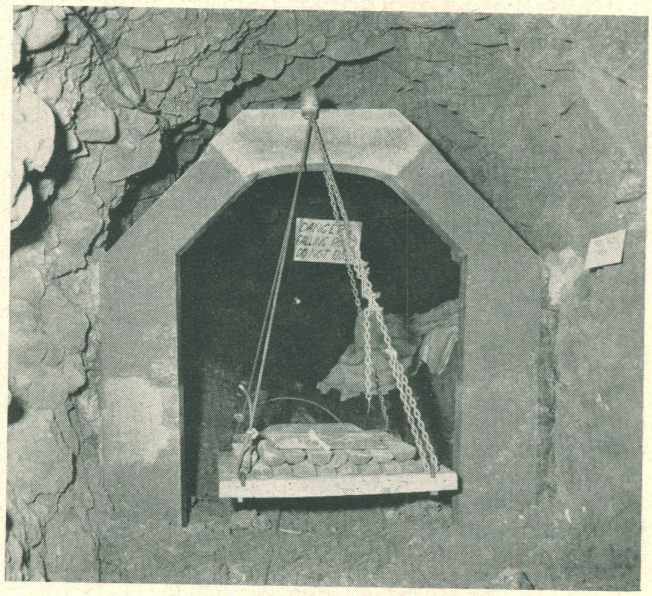
Considering the engineering properties of permacrete (the term adopted for frost-cemented artificial mixtures), it is apparent that military installations and shelters can be constructed in permafrost with the same degree of safety as in rock, and that the low temperature of permanently frozen ground can be used to advantage. Concrete work in cold regions, or during cold seasons, presents a number of difficulties. To use the cold advantageously, it is only necessary to omit portland cement from the concrete mix and allow it to freeze. Experiments with various mixtures indicate that ⅓ gravel, ⅓ sand, and ⅓ clay, saturated with water, makes an excellent "concrete" in a permafrost tunnel. In contrast to concrete, permacrete is somewhat insensitive to the inclusion of clay, which may be present in quantities up to 50 percent.

Columns for roof support, beams, arches, and ties have been manufactured from permacrete and are still undergoing tests. Permacrete floors and instrument foundations have also been used successfully. Even furniture, such as benches and tables, has been formed with permacrete.

Permacrete has less rigid requirements than ordinary concrete, is much easier to handle and control, and is very economical. Its properties are comparable with those of portland cement concrete, but are dependent upon temperature. Especially promising is the outlook for precast permacrete construction work.

Underground shelters in permafrost are natural sites for the application of permacrete. Taking advantage of the low temperature during the cold season, permanent construction from permacrete is feasible on the surface using the natural heat sink of the permafrost.[4] A minimum amount of insulation protects permacrete from melting during the summer.

[4]Any summer heat entering the structure will be absorbed easily by the underlying permafrost.



Test of Precast Permacrete Arch

Surveys and Maps

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Current Surveying and Mapping News

Coast and Geodetic Survey

OCEANIC EXPLORATION

The Survey Ship *Pioneer*[1] returned to San Francisco in the latter part of October following seven months of explorations in the North Pacific Ocean. The ship traveled 32,000 nautical miles and surveyed 175,000 square miles of ocean area between Hawaii and Alaska.

Laden with scientific data, geological samples, and marine specimens, the *Pioneer* concluded the first season of comprehensive oceanographic studies in which the emphasis has been on the total exploration of the sea. Data-collecting consisted of recording water depth, temperature, salinity and chemical composition, ocean currents, bottom cores and sediments, meteorological data, and magnetic and gravity surveys. Much of the data will be processed aboard the *Pioneer,* while other records will be sent for processing to the headquarters of the Coast and Geodetic Survey (C&GS) or to the National Oceanographic Center in Washington.

Throughout the 1961 season, the *Pioneer* towed a torpedo-shaped instrument—a magnetometer—about 500 feet astern. This instrument measures the total field of the earth's magnetic intensity and, combined with data made from the seaborne gravity meter, provides a unique comparative study for the geophysical scientists. Plotted composite profiles showing the course navigated by the ship, depth of water, gravity data, and magnetic intensity are now in preparation by the C&GS research staff in Washington. Considerable difficulty is usually encountered in taking gravity readings at sea because of the roll and pitch of the ship, drifting, and rough bottom topography. The C&GS has worked consistently during the summer to improve the quality and reliability of gravity surveys at sea. Anomalies discovered in magnetic and gravity surveys will be "contoured" on maps to aid in the interpretation of the earth's total geophysical profile. This is the first time gravity data have been available for geophysical studies of the extensive Aleutian Trench. Interpretation of these composite data will assist in understanding the structure of the earth and the processes which account for its surface features.

Co-operating in this ocean-wide survey, the Geological Survey sent scientists to the *Pioneer* with coring devices and instruments to take and analyze sediment cores from the deep ocean areas. One scientist from the Geological Survey examined atmospheric pollutants over the ocean. The geologists assisted in taking the samples at each oceanographic "station," in the preparation of field descriptions, and analyzed the "fresh" cores aboard ship. Also among the co-operating agencies was the Bureau of Commercial Fisheries, which concentrated its efforts in the measurement of zooplankton as related to the salmon fisheries, primary productivity rates, and phytoplankton standing crops, using this cruise to select the best conventional techniques that may be applied to future studies in the central Pacific and Indian Oceans. Completing the scope of scientific investigations was a scientist from the Scripps Institution of Oceanography of La Jolla, California, who studied the radioactivity of the surface and intermediate waters.

Through close co-operation between the C&GS and the Weather Bureau weather balloons were launched into the atmosphere and weather data were reported to United States stations every six hours.

Precision instruments developed in the fields of oceanography, geology, meteorology, and marine biology have permitted this important "look" into the inner space of the oceans just as satellites are probing the outer space of the atmosphere. The *Pioneer* scientists are seeking a big comprehensive "look" at oceans by navigating their ship along carefully spaced lines to avoid the possibility of leaving "gaps" in the area.

The first of many discoveries from this methodical ocean-wide survey was 34 new seamounts rising 3,000 to 6,000 feet and extending over a 1,000-mile area. The newly discovered mountains lie in the area just south of Alaska and the Aleutians, extending about half the distance from Alaska to the Hawaiian Islands.

The North Pacific Ocean project will eventually cover a 3,000,000 square mile area, requiring many years of concentrated effort. The 1961 phase covered about 5 percent of the total area.

On her return from Honolulu to San Francisco, the *Pioneer* ran a deep-sea sounding line and occupied a number of new oceanographic stations.

SMALL-CRAFT CHART

The Coast and Geodetic Survey recently published the fourth in a series of small-craft charts. The new chart, especially adapted for small-craft navigation in the San Francisco Bay-Antioch area, is known as Series 165. Designed to promote safety in navigation, the chart folio contains three fold-out charts particularly suited to the pleasure boatman for plotting in close quarters. Tide tables, rules of the road, whistle signals, symbols and abbreviations, storm warning signals, and instructions for obtaining daily weather forecasts all add to the wealth of navigational data bound together in a flexible and attractively designed cover. Another worthwhile feature is the number of facilities available to small craft for docking, supplies, fuel, and services that are tabulated and keyed to the chart.

GEODETIC AND CURRENT SURVEYS

A 25-man triangulation party is conducting survey operations in southwestern Kansas covering an area of approximately 5,500 square miles. The party will locate within the area a network of horizontal control stations establishing the exact latitude and longitude of selected points on the earth's surface at intervals varying from 5 to 10 miles. In southern Illinois, in an area of approximately 6,000 square miles surrounding Mount Vernon, a 35-man triangulation party is conducting survey operations which will require from four to five months before all the control stations in the area are established. A triangulation party of 16 men is establishing a network of horizontal control stations in the vicinity of Portland, Oregon, and Vancouver, Washington. In outlying areas of Portland and Vancouver, measurements will be made from tall steel towers centered exactly over points on the ground, while in the metropolitan areas observations of flashing light beams will be made from wooden stands on the ground or from tall buildings or other structures which can be seen by the observers.

A geodetic survey team of 20 men, operating in the vicinity of Chattanooga, will locate a network of geodetic control stations establishing the exact elevation above mean sea level and exact latitude and longitude of

[1]Commanded by Capt. William F. Deane, and carrying a complement of 14 officers, 90 crewmen, and a staff of scientists.

selected points on the earth's surface along a narrow corridor extending from Sweetwater, via Chattanooga, to Manchester. An 18-man field party is conducting leveling survey operations between several different localities in southern California: from Pasadena to Mt. Wilson, Azusa to 18 miles north of Azusa, Colton via El Cajon to Barstow, Colton via Redlands and Big Bear to Victorville, and Altadena to 8 miles north of Altadena. The party will locate along the prescribed routes accurately spaced control stations establishing the exact elevation above mean sea level of selected points on the earth's surface.

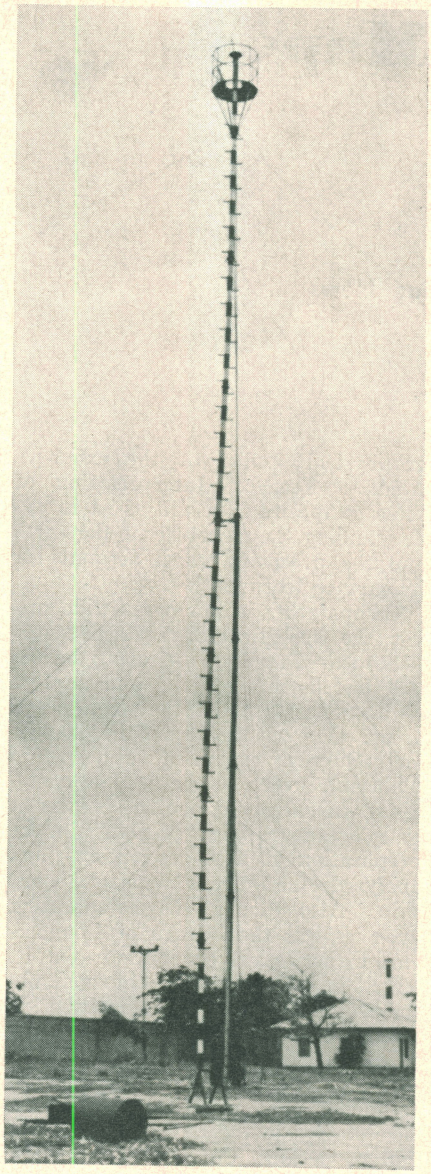
The Survey Ship *Marmer* is conducting current surveys at selected stations between South Capitol Street Bridge in Washington, D. C., and Dahlgren, Virginia, on the Potomac River. Results of the current survey of the Potomac will furnish mariners with up-to-date information on the direction and velocity of the currents under certain bridges, at river turns, and at narrow stretches where changes in the velocity have been known to exist.

Portable Towers for Colombia Surveys

Ingenuity is a requisite in field surveying. An excellent example of the imagination employed by the Inter American Geodetic Survey (IAGS) and the Instituto Geografico "Agustin Codazzi" (IGAC) in making a difficult survey is the design and construction of a new type of portable tower.

In areas of dense vegetation it is necessary either to clear a line-of-sight between the two observing points or to elevate the observing instruments above the obstructions. In most cases the latter procedure is the more economical. Bilby towers are generally employed for this purpose. Although designed for portability, Bilby towers are heavy. Some 20 helicopter trips are required to transport one tower, and construction may take as long as four days. When the IGAC-IAGS were planning a survey in the swampy, unpopulated basin of the Cauca Valley, they looked for other means of elevating the observing instruments above frequently inundated swamp. For this purpose they designed and constructed a tower from 6-inch seamless aluminum tubing, procured locally in 18-foot sections. The tubing was fitted with aluminum flanged couplings at each end. A step was attached every 15 inches and a platform was built on the top section. Guy wires with turnbuckles were fastened to the sections to stabilize the tower and to permit it to be plumbed after erection. A 53-foot gin pole was used to pull the assembled tower to an upright position.

Only six helicopter trips were necessary to transport the 950-pound tower.



Survey Tower of Seamless Aluminum Tubing in Colombia

The total cost was $2,000. The tower has proved to be especially helpful in flat areas where basic map control is being established. The use of helicopters has made it possible to move, erect, and dismantle the tower in one day, then move to the next site the following day. The observing features are basically the same as on a Bilby tower, although the rejection rate was approximately 10 percent because of tower movement. Vertical angle observations seem to be unaffected.

Hydrographic Office

DYE DISPERSAL TESTS IN HARBORS

The increased use of nuclear reactors to power naval and merchant ships has raised a question as to how efficiently harbors in which these ships operate are flushed, although the likelihood of an accident whereby a large quantity of radioactive material is released into the water is remote.

The Hydrographic Office has found that the rate at which a contaminant decreases in concentration and is transported out of a harbor depends on the amount of water brought in from offshore during each tidal cycle, the strength and direction of currents, the amount of fresh water runoff into the harbor, and the degree of turbulence or mixing taking place in the water. Using quantitative relationships, estimates were made of the flushing times of a number of important harbors.

To test the validity of the estimates, dye dispersal tests are being conducted in harbors for which the predictions were made. A dye dispersal test[2] consists of dumping a known concentration of a brilliant red fluorescent dye, rhodamine B, into the water and monitoring its decrease in concentration and its movements by using a fluorometer. The dye can be detected in concentrations as dilute as 2 parts in a billion and its progress has been followed for as long as nine days after injection into the water.

Results of the field surveys agree essentially with predicted results. For example, the prediction of a flushing time of six tidal cycles, about three days, for Portsmouth, New Hampshire, was borne out by the tests. However, the tests give much more detailed information than can be hoped for from predictions. Little embayments within a harbor wherein the circulation is sluggish and the dye tends to remain longer than average are revealed. Also variations in flushing rates result from introducing the dye into the harbor in different locations.

NATIONAL OCEANOGRAPHIC DATA CENTER

The National Oceanographic Data Center, Washington, D. C., is approaching full operation. Its mission is to acquire and process, by machine methods, oceanographic data for rapid retrieval. The facility provides oceanographic data at cost to private, commercial, and Government activities.

The Data Center, which was officially opened on January 16, 1961, is managed by the Navy Hydrographic Office. The activity is sponsored and financed by the Navy Department, Department of Commerce, Department of Interior, National Science Foundation, and Atomic Energy Commission.

Work of the Data Center has so far been concentrated on processing bathythermograph, oceanographic station, and surface (temperature and salinity) data. Oceanographic station data have been almost completely processed for the North Atlantic and Indian Oceans. Plans call for continuing work on data from the other oceans and including processing of marine geological, biological, and sea ice data.

[2]Developed by the Chesapeake Bay Institute of Johns Hopkins University.

Geological Survey

PLASTIC MODEL OF RIES CRATER, GERMANY

A geological relief model of the famous Ries Crater (Rieskessel) in Bavaria has been constructed by cartographers of the Geological Survey, using clear plastic sheets piled one on top of another to separate contour map cutouts from standard shaded relief sheets. The model is expected to be especially helpful in current Survey studies of lunar craters.

The Rieskessel is an immense depression some 18 miles in diameter, which, together with Meteor Crater, Arizona, and Wabar Crater, Saudi Arabia, has been identified by scientists as meteoritic in origin.

The model was constructed by cutting out each one of 20 contours representing intervals of 20 meters (about 60 feet) in elevation, building up each level from a bottom of 380 meters to the highest point of about 740 meters. Between each 1/16-inch sheet went a thin layer of clear silicone oil to eliminate reflections. The topographic base maps used were obtained from Army Map Service. The geology of the area, which was compiled and generalized from German sources, was printed in eight colors on each map. Upon completion, the model was sealed in a plastic box about 25 inches by 18 inches by 2 inches. The horizontal scale of the model is 1:100,000 and the vertical exaggeration about 8 to 1.

The model has been under construction since early May and the result is called a "Vita Vue" production "because it produces a striking illusion of realism."

For more than 100 years the crater had been generally considered to be the result of a volcanic explosion about 20,000,000 years ago during the Late Upper Miocene Period. New findings have changed this long-accepted theory.

Within the huge crater are several communities and the old walled city of Nördlingen. In some places the crater has been eroded so much that the rim is scarcely discernible. The crater floor is largely covered by alluvium and Late Upper Miocene fresh-water limestone. Here and there within the crater, hills of shattered crystalline granitic rocks and breccia of Triassic and Jurassic sediments rise above the alluvium. Similar brecciated rocks were thrown out of the crater and now lie some 5 to over 10 kilometers from the crater rim. This geology is vividly portrayed in color on the new plastic model.

MAPS OF ANTARCTICA

Three new topographic maps along the coast of Wilkes Land in Antarctica have been published by the Geological Survey at 1:500,000 scale (about 8 miles to the inch). The maps have a contour interval of 1,000 feet. Eight other maps in this area were produced earlier. Wilkes Land is on the part of the Antarctic Continent facing the Indian Ocean. The new maps lie between 112 degrees 30 minutes and 127 degrees 30 minutes east longitude and were compiled from aerial photography obtained on the Navy HIGH JUMP Expedition in 1946-1947.

All Antarctic maps are being published in shaded relief editions in colors. This gives the map the appearance of a model of the area and makes the configuration of the surface more readily apparent to the general map user. The visible surface of the vast interior of Antarctica (one and one-half times as large as the United States) is primarily composed of gently rolling, snow-covered expanses. The snow and ice cover is sometimes 3 miles thick. The only features are crevasses, rivers of ice, and sastrugi, repetitious patterns of wind-driven snow.

Working during periods of continuous daylight, Survey engineers in the Antarctic have made position determinations based exclusively on solar observations. As the sun in Antarctica is always at a low altitude, atmospheric refraction introduces a varying degree of uncertainty in the accuracy of results. Recent innovations in observation techniques have made it possible to make antarctic position observations on navigational stars in daylight. Tests indicate that the new method may permit stellar observations at sufficiently high altitudes to preclude significant refraction error, and shorten necessary observation time.

In addition to position measurements, tellurometers are used to measure distances electronically. The instruments were tested during last season's operations and found to be reliable even under antarctic conditions. This season, two gas-turbine helicopters from the Army Transportation Board, Fort Eustis, Virginia, will be used. These helicopters are able to hover at 12,000 feet elevation. The length of the planned traverse from McMurdo Base to the head of Beardmore Glacier measures 875 nautical miles. A typical day's operation calls for the measuring of four traverse legs or about 60 miles of traverse. The daily camp will be established by a standby Navy Otter aircraft.

Current compilation procedures involve World War II trimetrogon techniques, utilizing photographs made by three aerial cameras that take high oblique photographs on both sides simultaneously with a vertical photograph at each camera station. Photographic missions are flown by the Navy.

Last year, some 118,800 square miles of usable photographic coverage were completed. Plans call for adding 270,000 square miles during the current season.

The Geological Survey is now compiling twenty-two new maps of Antarctic areas at 1:250,000 scale with 200-meter contours. This mapping includes ten maps in the Horlick Mountains, three in the Sentinel Range of the Ellsworth Mountains, three in the Executive Committee Range, and six in McMurdo area. Manuscript copies will be processed quickly over the next four months so that research projects will have the most up-to-date maps possible for use in field investigations.

The Geological Survey is also preparing a two-layer, plastic relief model of Antarctica at a scale of 1:10,000,000 which will include the tips of the surrounding continents. The bottom layer will show the ocean floor, nunataks and identifiable land areas, including portions of the continent that now lie buried beneath perpetual snow and ice; the removable top layer will show the sea level surface and the present ice mass with the projections of the mountain tops above the ice.

The mapping program of the Geological Survey is part of a continuing program in Antarctica. The field effort during the current season will be contributory to a $303,000 antarctic mapping program sponsored by the National Science Foundation as part of the Antarctic Research Program. Air transportation and logistical support are to be provided by the Army and the Navy.

Copies of the 1:500,000-scale reconnaissance series Antarctic maps may be obtained from the Geological Survey, Department of the Interior, Washington 25, D. C., at 50 cents each.

NEW TOPOGRAPHIC MAPPING

New or resurveyed topographic quadrangle maps published during September and October of 1961, including maps compiled by other Federal agencies but edited and published by the Geological Survey, are listed as follows:

Alabama:
Brewton North
Brewton South
Cleveland
Alaska:
Big Delta C-5, D-5
Mount Hayes C-5
Talkeetna A-1, A-2, A-3, D-6
Tyonek A-6, C-2, C-6
Arizona:
*Silver Bell Peak
Arizona-New Mexico:
*York Valley
Arkansas:
Portland
Wilmot NW
Arkansas-Louisiana:
Wilmot
Wilmot SW
California:
Agua Dulce
Barrett Lake
*Caliente Mtn.
Cuyamaca Peak
*Fortuna
Hot Springs Mtn.
Mint Canyon
Morena Reservoir
Painted Rock
St. Helena
Tecate
Tule Springs
Viejas Mountain
Whispering Pines
*Yosemite
Colorado:
*Bonanza
Grandview School
Nucla
Rockvale
Georgia:
Glennville SE
Groveland
Limerick SE
Walthourville
Idaho:
Robinson Lake
Illinois-Indiana:
Grayville
Indiana:
Fairmount
Gas City
Greens Fork
Greentown
Hartford City East
Jacksonburg
Liberty
Mentone
Point Isabel
Tipton
Winchester
Indiana-Ohio:
Dixon
Union City
Louisiana:
*Eva
*Jonesville

Louisiana-Texas:
Echo
Orange
Missouri:
Barnett
Montana:
*Ravenna
Nebraska:
Hay Springs SW
Oak
Nebraska-Kansas:
Byron
Chester
Nevada:
*Ely
*Goodsprings
*McCullough Mtn.
*McGill
*Preston Reservoir
*Sloan
North Carolina:
*Saint Pauls
North Dakota:
Galchutt
Mooreton West
Power
Wyndmere NW
Wyndmere SE
Ohio:
Albany
Attics
Ayersville
Bloomville
Celina
Centerton
Columbus Grove
Continental
Dellroy
Deshler
Elgin
Elida
Erastus
Fleming
Glenmore
Hamler
Homeworth
Hoytville
Junction
Lansing
Leipsic
Moulton
New Riegel
North Kingsville
North Robinson
Oberlin
Painesville
Richmond
Rockford
Thompson
Watertown
Wauseon
Willard
Ohio-Indiana:
College Corner
Ohio-Michigan:
Fayette
Morenci
Ohio-West Virginia:
Pomeroy
Oklahoma:
*Hammon
Pennsylvania:
Lehighton
South Dakota:
Aberdeen West
Northville
Rudolph
Tennessee:
Cassville
Curtistown
Dibrell
Doyle
Sligo Bridge
Texas:
Boyd
Bridgeport West
Briggs
*Claude
Concrete
Cottondale
Cuero
Decatur
Ding Dong
East Bernard
Fairview
Groesbeck
*Groom
Lacoste
Lansing
Losoya
Ponder
Rexville
Saint Hedwig
Sanger
Somerset
Sunny Side
Tehuacana
Thelma
Tool
Waller
Wallis
Youngsport
West Virginia:
Gladesville
Masontown
Peniel
Wyoming:
*Betty Reservoir
*Savageton

Maps designated by an asterisk (*) are at the scale of 1:62,500. All other maps listed are at the scale of 1:24,000 except the quadrangles in Alaska which are at the scale of 1:63,360.

Quadrangle maps for areas east of the Mississippi River may be purchased from the Washington office of the Geological Survey. Maps west of the Mississippi should be ordered from the Geological Survey regional office, Denver Federal Center, Denver 2, Colorado.

Lake Survey

1961 FIELD OPERATIONS

During the 1961 field season, Lake Survey operations were conducted on all lakes except Lake Superior. Inshore hydrographic surveys were made on Lake St. Clair and the south shore of Lake Erie using shoran as a means of positioning the survey boat, and along the west shore of Lake Erie and on the Maumee River, using transit cut-offs for location. Data from these surveys will be used for new editions of the present charts of the areas and for compiling new small-boat charts in booklet form.

Horizontal control was established by tellurometer traverse in advance of the hydrographic surveys along the west and south shores of Lake Erie, the northwest shore of Lake Huron, and the Maumee, Sandusky, and Portage Rivers in Ohio.

Triennial revisory surveys were made of all United States harbors on Lakes Erie, Ontario, and Champlain, along the Niagara and St. Lawrence Rivers, and on the rivers, canals, and lakes of the New York State Barge Canal System. These data are used to bring current charts up to date by issuance of new editions.

Discharge measurements were made in the Detroit and Niagara Rivers to verify existing stage-discharge relationships.

New permanent water-level gages were established at the Enrico Fermi Nuclear Power Plant near Monroe, Michigan, and on the new harbor dock at Harrisville, Michigan. A temporary water-level gage was maintained in Milwaukee Harbor at the pumping station to determine the feasibility of establishing a permament gage at this location. Eleven seasonal water-level gages were maintained in various harbors to compile data for crustal movement studies.

Army Map Service

RIGHT-READING ENGRAVING

The introduction of the scribed plastic-coated sheet to the map reproduction process has been one of the most spectacular advances in mapping procedure. Whereas maps once were compiled and laboriously drafted with pen and ink, present procedures employ scribing instruments and the plastic-coated sheet for quicker, more uniform results. The map image has been scribed in reverse, since it has been essential that the emulsion side of the plastic be placed in contact with the metal lithographic plates. (The thickness of the plastic was sufficient to cause a "blurred" image if it came between the emulsion and the lithographic plate.)

Experiments at Army Map Service with pin-point light sources and the adoption of chemical reversal processing techniques are now making it possible to engrave right-reading images. The advantages to be gained by scribing in right-reading form are obvious. It will no longer be necessary to orient the draftsman in "mirror images" and the whole process from engraving through checking will be simplified.

American Geographical Society

MAP OF ANTARCTICA

Under a grant from the National Science Foundation, the American Geographical Society has just compiled a 1:3,000,000-scale map of Antarctica. This map, in four quadrants each 42 inches by 42 inches, prepared from survey and traverse data, is for the United States Antarctic Research Program. It shows selected soundings and elevations, snow traverses, auxiliary bases and depots, as well as the conventional land, sea, and ice forms. Names follow the recommendations of the United States Board on Geographic Names.

The map, in the form of contact prints on ozalid, is for sale by the American Geographical Society, New York, at $7.50 for each set of four quadrants.

New County Maps

The county highway mapping program is a continuing activity in the highway departments of the several states. In most cases the new editions are completely redrafted, representing material improvements over the superseded editions. In connection with the national co-ordination of the program, the Bureau of Public Roads receives copies of all new maps as they are issued. New county maps thus received in Washington during September-October 1961 are listed as follows:

Alabama
Cherokee
Jefferson
Arkansas
Bradley
Cleveland
Garland
Colorado
Adams
Eagle
Lake
Georgia
Bleckley
Calhoun
Crawford
Decatur
Elbert
Fannin
Gilmer
Lumpkin
Macon
McDuffie
Mitchell
Terrell
Walker
Webster
Kansas
Stafford
Thomas
Kentucky
Elliott
Jackson
Laurel
Mercer
Pulaski
Rockcastle
Shelby
Whitley
Wolfe
Louisiana
Morehouse
Vernon
Maryland
Calvert
Caroline
Prince Georges
Talbot
Mississippi
Choctaw
Clay
Humphreys
Lauderdale
Sunflower
Washington
Nebraska
Sioux
Stanton
New Mexico
Los Alamos
Luna
Otero
Rio Arriba
North Carolina
Beaufort
Bertie
Bladen
Brunswick
Cherokee
Columbus
Craven
Gates
North Dakota
Barnes
Dickey
Eddy
Emmons
Foster
La Moure
Pierce
Rolette
Sheridan
Stutsman
Oregon
Grant
South Dakota
Davison
Hanson
Lake
McCook
Minnehaha
Miner
Moody
Tennessee
Cumberland
Davidson
Meigs
Rhea
Scott
Texas
Brown
Castro
Coleman
Comanche
Eastland
Ellis
Lampasas
McCulloch
San Saba
Stephens
Utah
Millard
Vermont
Orleans
Washington
Wahkiakum
Wisconsin
Ashland
Brown
Chippewa
Dodge
Fond du Lac
Forest
Kenosha
Marathon
St. Croix
Wyoming
Crook
Hot Springs

Magazine Digest

Selected Articles for Engineers

AMÉRICAS

And the Earth Shook. *By Capt. Elliott B. Roberts.* Some of the underlying reasons for earthquakes, factual and theoretical, are given and unusual features are described. *(July 1961)*

ARMY

The Defense of Free Europe. *By Gen. Bruce C. Clarke.* Defense, combat, friendship, and understanding are the missions of the United States Army, Europe, as stated by its commander. *(October 1961)*

CALCIUM CHLORIDE NEWS

Chemical Mixtures Melt Ice Fast. Mixtures of calcium chloride and sodium chloride, used when temperatures are 30 degrees Fahrenheit and below, are being employed on the Ohio Turnpike with effect and economy. *(Third Quarter 1961)*

CONSTRUCTIONEER

Inlet Protection. *By Maj. Gen. William F. Cassidy.* The work of the Army Corps of Engineers on the Atlantic and Pacific inlets is described briefly. *(August 21, 1961)*

Salt Stabilization Keeps Franklin Falls Road Open. *By Ken Smith.* A gravel road in Franklin County, New York, stabilized with rock salt brine, stood up throughout the spring season of breakup and mud. *(October 30, 1961)*

THE CONSTRUCTOR

Contractors Turn Over First Titan ICBM Bases to Air Force. On August 4, the heavy construction phase of an operational squadron at Lowry Air Force Base, Colorado, was completed. Two million cubic yards of earth were moved, 100,000 cubic yards of concrete placed, and 35,000 tons of steel used in this first of eight such bases. *(September 1961)*

ENGINEERING JOURNAL (CANADA)

The Yard or the Metre, Which? The summary of a panel discussion at the 1960 Annual General Meeting of the Engineering Institute of Canada. *(June 1961)*

FORTUNE

The Economy Can Survive Nuclear Attack. *By Gilbert Burck.* The United States has no sure military defense against a colossal nuclear attack, yet it can survive the holocaust, rebuild its industries, and revive its way of life if it prepares itself fully and soon. The necessary preparations, under way or proposed, and suggestions for additional action are stated. *(November 1961)*

GLOBAL TECHNOLOGY

Can Aluminum Supplant Steel in Fabricated Assemblies? High-speed, high-temperature welding now makes the use of aluminum and its alloys practical. Light-metal welding techniques are discussed and examples given. *(August 1961)*

HAWAII INDUSTRY

Volcanic Steam Drilling Continues. Tapping live steam from underground volcanic sources, successfully prosecuted elsewhere, is now being undertaken on the island of Hawaii, but so far without finding live steam at a pressure required for commercial use. *(September 1961)*

JOURNAL OF THE BOSTON SOCIETY OF CIVIL ENGINEERS

Construction of Dry Dock Number 6, Puget Sound Naval Shipyard. *By Capt. Perry Boothe.* The construction of a dry dock of sufficient capacity to take a Forrestal airplane carrier is described. It is probably the deepest dry dock in the world; certainly the one with the greatest volume. *(July 1961)*

MACHINERY LLOYD

Singapore. A wealth of statistics about this Far East island state, primarily for the businessman. *(July 8, 1961)*

MECHANICAL ENGINEERING

Ultrahigh Strength Materials of the Future. *By John J. Gilman.* We are now on the verge of a revolution in which strength of materials will increase into the million-psi range. What will these new materials be like? How will we employ them? *(September 1961)*

MILITARY REVIEW

The Siege of Sevastopol. *By Dr. Cornelius C. Smith, Jr.* The highlight of one of the most poorly managed campaigns in history. *(June 1961)*

NATIONAL DEFENSE TRANSPORTATION JOURNAL

Amphibians Against the Fifth Element: Mud. *By Lt. Comdr. Julius Grigore, Jr.* Today's amphibious surfing transports cannot move over soft terrain, according to the author, who analyzes amphibious vehicles and their ability to negotiate mud. *(July-August 1961)*

PROFESSIONAL ENGINEER

The Story of the Zero. *By Bernard F. Pierce.* How the decimal system evolved and why it proved superior to the Roman and Greek counting systems. *(August 31, 1961)*

ROADS AND STREETS

Bailey Bridges Cut Freeway Haul Road Costs. One of the latest peacetime uses of this World War II bridge was in connection with the construction of a 10-mile section of the San Diego Freeway. Here it was used to span existing heavily traveled arteries, thus materially reducing hauling distances. *(September 1961)*

ROYAL ENGINEERS JOURNAL

The Engineer-in-Chief's Address to the 1961 General Meeting of the Corps. *By Maj. Gen. T. H. F. Foulkes.* The world-wide activities of the Corps are covered, including the situation of regular army engineers, the civilianization of the works services, unit activities at home and overseas, and reorganization of the reserves. Training, equipment, and personnel matters are also discussed.

The Development of Engineer Equipment for the Army. *By Brig. H. A. T. Jarrett-Kerr.* Present trends are described comprehensively.

Hovercraft as Tank Carriers. *By Maj. A. J. D. Hughes.* Military and technical considerations, vulnerability, design, movement, and engineer support are discussed. *(September 1961)*

TRAFFIC QUARTERLY

New Rapid Transit Planning. *By Leslie Tass.* Only the most efficient rapid-transit systems will be able to relieve the street congestions of large cities. *(October 1961)*

U. S. NEWS & WORLD REPORT

U. S. Ahead in Arms Race? Lt. Gen. Arthur G. Trudeau, Army Chief of Research and Development, states that our troops are well supplied with arms, transportation, tanks, and missiles, particularly in Europe. He is confident that the Nike-Zeus, the antimissile missile, will prove successful in destroying incoming missiles. *(September 18, 1961)*

NEWS and COMMENT

Industry • Armed Services • Education • Features

NOTE: Any literature mentioned in this section and further information about any of the news items may be obtained through THE MILITARY ENGINEER as well as from the direct sources listed.

Position Openings

United States Army

Corps of Engineers, vacancies for civil, electrical, mechanical, and structural engineers at salaries of $6,435 to $8,955 at:

Engineer Center, Fort Belvoir, Va.
Fort Worth District, P.O. Box 1600, Fort Worth, Tex.
Louisville District, P.O. Box 59, Louisville, Ky.
Omaha Engineer District, 1709 Jackson St., Omaha 2, Nebr.
Vicksburg Engineer District, P.O. Box 60, Vicksburg, Miss.

United States Navy

Department in general, Washington 25, D. C., announces many vacancies in almost every field of engineering at salaries of $4,345 to $10,320 in Washington, elsewhere in the United States, and overseas.

Navy Overseas Employment Office, Federal Office Building, San Francisco 2, Calif., vacancies in Guam for general and maintenance engineers; in Hawaii for electronic and general engineers; in Korea for electronic engineers; in Laos for general construction engineer; and in Vietnam for construction inspectors, at salaries of $7,560 to $13,510, with 17½ percent to 25 percent differential in addition.

12th Naval District Civilian Personnel Office, Federal Office Building, San Francisco 2, Calif., vacancies in the west for chemical, electrical, electronic, general, industrial, mechanical, and welding engineers at salaries of $6,435 to $12,210.

District Public Works Office, 14th Naval District, Navy No. 128, FPO, San Francisco, Calif., vacancies in Hawaii for fire prevention and supervisory general engineers at salaries of $8,955 to $10,255, with 17½ percent differential in addition.

United States Air Force

Middletown Air Materiel Area, Recruiting Section, Personnel & Administration Office, Olmsted Air Force Base, Penn., vacancies for aircraft modification design, electronic, general, industrial, and mechanical engineers at salaries of $5,355 to $8,955 per annum.

United States Coast Guard

Department in general, Washington 25, D. C., announces a vacancy for a construction specifications writer at a starting salary of $8,955.

Form 57, obtainable at first class post offices and from the Civil Service Commission, Washington, D. C., should be submitted to the government agencies listed above.

Operations on Biak

TO THE EDITOR:

Apropos the article on Biak in this issue,[1] after desperate fighting in the caved cliffs near the landing area, American troops of the 41st Division advancing west (away from the sea) had captured the air-base area and passed one of the cave areas bordering the airstrips on the east. However, there remained pockets of Japanese (as usual), of whom over 100 attempted to attack the rear and headquarters of the 186th Infantry. The regiment had halted for the night of June 21-22, 1944, and had dug in facing east. Fortunately the 41st Division had been fighting the Japanese for more than two years, so that all-around night defense was "SOP." The regimental cannon platoon with .30- and .50-caliber machine guns was deployed across the trail and facing the rear.

As the Japanese made an all-out Banzai attack at dawn on June 22, the machine guns opened up, killing all 108 Japanese. Only one American was wounded.

In the accompanying picture, we are looking at the dead Japanese soldiers, fallen like dominoes along the trail by which we had come, right up to the guns of the cannon platoon. In this picture, taken about an hour after the fight, General Eichelberger, in praising the men, asked them who in their opinion had been the best leader. Their unanimous choice was "Red," the man on the right of the picture with glasses and rifle. "Come over here, Red," said General Eichelberger. And he decorated Red with the Distinguished Service Cross on the spot.

This combat incident illustrates (1) the fanatical nature of the enemy soldier of World War II and of any future war with Orientals, as they do not surrender; (2) the necessity for all-round defense in jungle and guerrilla warfare; and (3) the kind of award that really counts—that for bravery on the spot.

What was I doing on Biak? Gen-

[1] *Cave Warfare on Biak,* by Kenneth J. Deacon, page 4.

Col. S. D. Sturgis, Jr., Engineer, Sixth Army (left), Lt. Gen. R. L. Eichelberger (pointing), and members of the American attacking force, June 22, 1944, on Biak after the attack that morning.

eral MacArthur had sent an urgent dispatch to General Krueger (6th Army C. G.) at his Hollandia, New Guinea, headquarters, on June 15, pointing to the great need for operational air bases on Biak. So, as Army Engineer, I was dispatched by LST to get air bases operational within 48 hours of arrival.

The difficulty was the caves in the coral cliffs in which Japanese had holed up and which they had improved and connected. This produced a virtual stalemate. The LST's in my convoy carried reinforcements.

Within two days all of the air-base area was captured except the caves. In spite of harassing fire from these caves, the 863d Engineer Aviation Battalion[2] put one drome in operation very early. And, by June 19, the 112th Engineer Group[3] had Owi Island strip operational although cut out of virgin rain forest. Owi was 3 miles off the coast and not occupied by Japanese.

The afternoon of June 22, I spent with the 186th Infantry-116th Divisional Engineer teams, who were cleaning out the caves chiefly with hand grenades and flame throwers.

SAMUEL D. STURGIS, JR.
Lieutenant General
United States Army Retired

The Eads Bridge

TO THE EDITOR:

With reference to "Bridges through the Ages,"[4] a statement in the fourth paragraph, page 352, may be misleading. Hollow tubular chord members were not used on the Eads bridge. I presented several papers in which it was pointed out that the tubes were only thin shells banding together packed alloy steel flats. The ends were ground to a flat surface and a slight angle so as to ensure full end bearing of adjacent chord sections of the packed flats.

Encyclopaedia Britannica may give something on this. Also the A.R.E.A. made some studies on this bridge in the '30's and '40's concerning the substitution of HS bolts for rivets in connection with the track supports on the bridge. The railroad's research engineer and I discussed the make-up of the chords at some length.

G. G. GREULICH
Consulting Engineer
Fort Lauderdale, Florida

TO THE EDITOR:

Mr. Greulich's comments on the use of hollow tubular chord members on the Eads bridge are certainly most convincing. His first-hand knowledge of the subject should serve to purify some of the nomenclature which has been passed from one writer to another over the past several decades. Even as eminent an authority as the late Dr. D. B. Steinman apparently supported the "hollow tube" theory. An examination of Professor C. M. Woodward's *A History of the St. Louis Bridge* (St. Louis, G. I. Jones & Co., 1881) might give us a clue as to how the idea got started that the tubes—all, or maybe only a portion of them—were, in fact, hollow.

CHARLES J. MERDINGER
Captain (Civil Engineer Corps)
United States Navy

[2]Col. Raymond J. Harvey, commanding.
[3]Col. (later Brig. Gen.) D. W. Heiman, commanding.
[4]Part III, by Capt. Charles J. Merdinger [M.E. Sept.-Oct. 1961].

Soil Mechanics

TO THE EDITOR:

In the Department of Military Art and Engineering at the United States Military Academy, the articles from THE MILITARY ENGINEER that we used in our elective course last year with your permission were very helpful.

In our elective in Soil Mechanics this year, we are including two lessons on soil trafficability. We believe the articles listed below from THE MILITARY ENGINEER will add a lot to these two lessons, and we would appreciate permission to use them. "Trafficability of Soils," by W. J. Turnbull and M. P. Connaughton [Jan.-Feb. 1954]; "Military Geology," by Frank C. Whitmore, Jr. [May-June 1954]; "Vehicle Mobility on Soft Soils," by C. R. Foster and S. J. Knight [Mar.-Apr. 1957]; "Vegetation Studies for Military Purposes," by John C. Reed, Jr. [Nov.-Dec. 1957]; and "Military Geology in the Civil War," by Andrew Brown [May-June 1958].

RICHARD S. HARTLINE
Major, Corps of Engineers
Executive Officer

Army Engineer School Notes

FALLOUT SHELTER ANALYSIS COURSE

In July 1961, the President ordered a Fallout Shelter Program to provide shelters in the event of a nuclear attack.

The evaluation of public buildings on a national basis for use as fallout shelters is included in Phase I which is to be completed in 1962. To complete this task on time, a large number of engineering personnel must be trained in the evaluation of fallout shelters. An exact analysis of structures is extremely complex. However, a simplified analysis system which balances the complexity of analysis with acceptable standards of accuracy has been developed.[5] It includes: radiation shielding analysis, environmental engineering, shelter modification and improvement techniques, and introductory material in the field of nuclear weapons effects. No intensive training course in these areas had been presented nationally.

Directed on July 21, 1961, to develop this course, the Army Engineer School assembled a qualified staff, prepared a program of instruction and obtained the necessary reference material, and started the first class on August 9, 1961. Many of the manuals and much of the reference material went directly from the School print plant to the class during the initial hour of instruction.

Students in the first class, which was for four weeks, were supervisory personnel of the Army Corps of Engineers and the Navy Bureau of Yards and Docks who had been selected to administer the field program. Succeeding classes, two weeks in length, are being conducted at the Army Engineer School, the Naval Civil Engineer School at Port Hueneme, California, and at various colleges and universities. Students are primarily engineering personnel from architect-engineer firms. Existing structures will be surveyed by architect-engineer firms under contract with Army Engineer Districts and Navy Public Works Offices.

[5]By the National Bureau of Standards and the Office of Civil Defense Mobilization.

ROCK CRUSHING PLANT

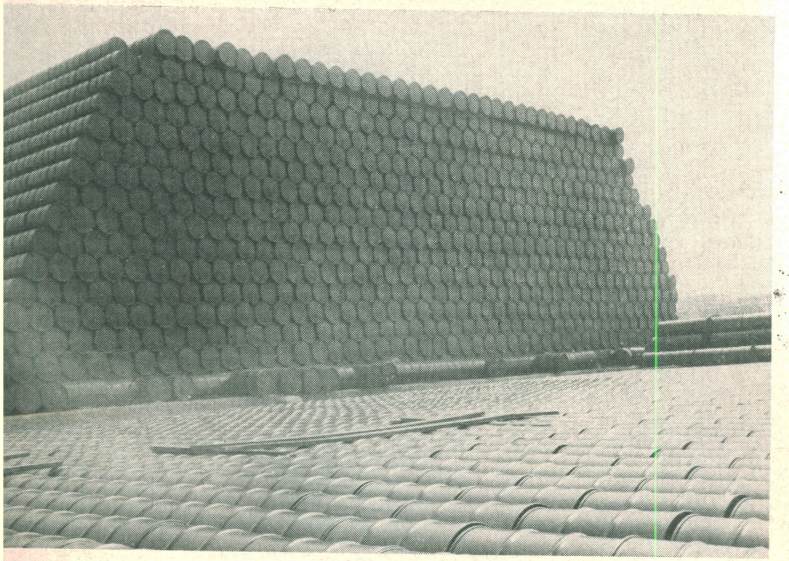
The new 75-ton-per-hour rock crushing and screening plant, designed specifically for military operations, comprises a primary unit consisting of an apron plate feeder, a 3-by-6-foot vibrating grizzly, a 20-by-36-inch overhead eccentric jaw crusher, and a belt conveyor; and a secondary unit made up of a demountable reciprocating plate feeder, a 30-by-20-inch dual roll crusher, and a two-deck vibrating screen. Motive power for the jaw and roll crushers is provided by diesel engines. All other mechanisms are driven by electric motors with the power provided by two 100-kw generators. Three 50-foot conveyors, also electrically operated, are included for stockpiling purposes.

During recent tests, the plant output averaged over 88 tons per hour in crushing a total of 14,000 tons.

At a later date a washing plant and a screening unit will be added. The former will consist of a high-speed drum washer, a three-deck vibrating screen, and a 22-inch screw dehydrator, all mounted on one chassis. The screening unit will be made up of a three-deck vibrating screen. Each unit will be electrically driven by a 100-kw generator. A 1,500-gpm pump will supply the necessary water. Nine additional electrically operated conveyors will provide for stockpiling.

When the entire plant is assembled it can produce from one to nine separate sizes of material.

According to present plans the plants will be listed as sets. Set 1 will consist of the primary unit, secondary unit, and three conveyors. It will be issued to units in support of combat troops. Set 2 will be made up of the washing plant, screening plant, nine conveyors, and the 1,500-gpm pump with pipeline. It will be issued with Set 1 to Engineer Construction Support Companies.



Order in the Storage Yard

Chaos after High Tide

Drums Away

A company in Texas City, Texas, which has a contract to fill and ship 55-gallon drums of petroleum products for the Army Quartermaster Corps, was the victim, along with Texas City, of a unique experience in the wake of Hurricane Carla which lashed the Texas Gulf Coast September 9-12, 1961.

The company had some 675,000 drums in storage at the time of the hurricane, stacked in neat piles 40 to 50 feet high over a 15-acre site. When the 4-foot tide swept over the site, drums were displaced, and just as a keystone releases an arch, so when one drum was released from the stack, others came tumbling down and floated away on the surging water. The drums covered the ground over an area of about a square mile after the water receded. Others floated into the residential and business districts of the city, coming to rest in streets, alleys, and yards, on fences, on doorsteps, and in driveways. The drums floated into refinery areas and tank farms, onto railroad tracks and highways, into ditches, and service stations. In all, about 410,000 drums were scattered over the city and vicinity. Some were picked up in front of the post office, about 4 miles from the storage yard.

For several days after the storm, the drums were merely pushed off the highways and tracks to clear the way for traffic. The drums then had to be gathered up and reconditioned. Large dents were removed by air pressure, the paint and rust were removed, and a new coat of paint was applied before the drums were finally returned to storage.

NCEL Notes

Current activities at the Naval Civil Engineering Laboratory (NCEL), Port Hueneme, California, are described:

Nuclear shielding factors for underground shelters of various shapes (TR-080) were investigated in comparison with the shielding afforded by a slab.

A study (TR-134) was made to determine the feasibility of fabricating a tent frame from such corrosion- and fire-resistant materials as magnesium, plastics, and aluminum, and a tent deck from plastics, concrete, stabilized soils, and corrosion-resistant metals.

A study (TR-138) sought the most suitable desiccant, associated equipment, and dehumidification machine which would permit the least amount of dust in warehouses. Dehumidification machines were observed in operation at Construction Battalion Center, Port Hueneme, California, and the Naval Supply Depots at Oakland, California, and Mechanicsburg, Pennsylvania. Tests indicate that dust is no longer a significant problem.

Thermoelectric devices and techniques were investigated to see if they meet the requirements of the Bureau of Yards and Docks. The survey (TR-142) indicates that they are unsuitable

Drums along Cleared Road a Half Mile from their Base

Gathering Up the Drums for Repair and Return to Storage

except in remote locations where conventional power sources are not available and where cost is not a prime consideration.

Five different commercial drawn-brass or silicon-bronze extinguishers, lined with a lead alloy, were tested with a lithium chloride solution, with sodium dichromate-oxalic acid or sodium dichromate alone as an inhibitor (TR-132). The tests indicate that 0.5 percent sodium dichromate is satisfactory.

Tests in support of requirements for the design of ship superstructures to resist nuclear blasts were made to determine the range of dynamic response, the static and dynamic yielding, local buckling, and ultimate rupture loads of aluminum beams (TR-148).

A frameless steel arch building was subjected to the loading specified by the uniform military requirements criteria for 40-by-100-foot prefabricated advanced-base buildings (TR-135). The ease of erection, structural adequacy, weather tightness, and suitability of commercial packaging were to be determined by the tests.

A 100-ton floating crane developed for use on pontoon barges at advanced bases was tested and found suitable (TR-149).

Tests (TR-172) of three types of pavement sweepers to determine their suitability for rapid radiological decontamination disclosed that a runway sweeper with an air nozzle was not adaptable, ordinary street sweepers have limited use, while the Air Force sweeper ARDS 100 DS was found adaptable to the task requirements.

ERDL Notes

The Engineer Research and Development Laboratories (ERDL) at Fort Belvoir, Virginia, was host for a three-day Image Intensification Symposium sponsored jointly by ERDL and by the National Aeronautics and Space Administration (NASA). It was attended by representatives of industry and government agencies.

A power pack for the Army Pershing Missile System, which is scheduled to replace the Redstone, has been developed by the Martin Company under the technical supervision of ERDL. The heart of the power pack is a 200-hp gas turbine engine. There also is an air cycle air conditioner, a 12-cfm, 3,000-psi air compressor, a 40-kva a-c generator, and two 300-ampere, 28-volt d-c generators.

Fused fiber optic plates suitable for use as coupling elements in image tubes are a recent development. A 1-inch-diameter plate is made up of approximately 15,000,000 individual glass fibers fused into a solid piece with suitable optical insulation between fibers. These plates are able to transfer an image from one side of the piece through the glass channels to the other side, where the image is reformed by a series of shaded dots similar to a newspaper photograph. The resultant image is high in resolution and contrast with negligible distortion.

ERDL has a new special tube to provide battlefield commanders with "ringside seats" at night operations conducted at distant sites. The "image intensifier orthicon" tube[1] combines the techniques of the image tube employed in the infrared snipersceope with the image orthicon type used in television broadcast systems. It facilitates the use of television systems without the need for floodlighting. To operate, all it needs is starlight, moonlight, or skyglow. Diffused natural light reflected from the target is amplified or intensified to present an image.

ERDL has released a report on a test of a Hunter portable, gasoline-burning, radiant heater in ambient temperatures as low as −38 degrees Fahrenheit in the vicinity of Fairbanks, Alaska. Designed for use in the field where heat is required for personnel in situations such as tire changing, brake adjusting, engine starting, thawing frozen fuel lines, et cetera, on automotive equipment, in improvised field shelters, and in comparable emergency situations, the heater permitted changing a tire with bare hands in temperature of −30 degrees Fahrenheit. Heat was radiated directly toward the operator during 45 minutes required to make the change. The tools and tire had been heated by the unit for 15 minutes beforehand to avoid danger of frostburn. The heater brought a 12-ounce can of field rations to a boil in 6 minutes in a temperature of −36 degrees Fahrenheit. It successfully thawed out frozen fuel lines of a crawler tractor when placed on the tracks of the crawler with heat directed toward the fuel lines. At −24 degrees Fahrenheit ambient temperature, a steel quonset (20 by 17 by 10 feet) with a wooden floor was warmed sufficiently to make it comfortable for prolonged activity by personnel wearing light gloves.

New Films

"George Spelvin, P. E.," a 22½-minute film on professionalism and engineering, is centered around a young engineer who is designing a fuel-handling memory and control system for a nuclear power plant. Through narration and dialogue, the film comments on professional ethics, graduate education, the EIT examination, participation in civic affairs, registration, public speaking, and the importance of personal cultivation in fields outside the technical area of specialized engineering. The film may be borrowed from the National Society of Professional Engineers, 2029 K Street, Northwest, Washington 6, D. C.

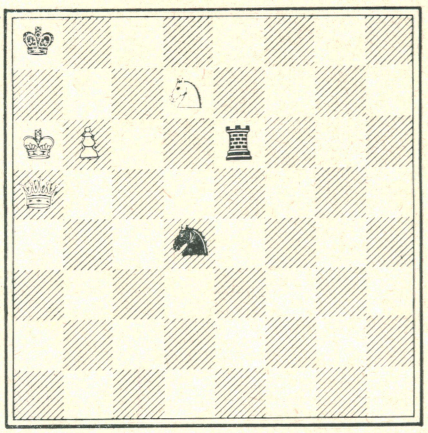
[1]Developed by Radio Corporation of America.

Chess

Solutions and comments are invited. The solutions to the following problems are published on page 54.

PROBLEM NO. 17

By Geoffrey Mott-Smith



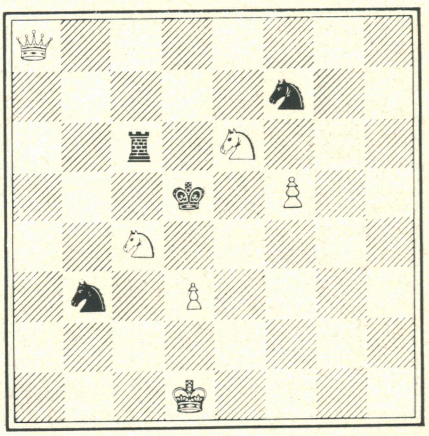
White (4 men): K on QR6, Q on QR5, N on Q7, and P on QN6.

Black (3 men): K on QR1, R on K3, and N on Q5.

White to play and mate in two moves.

PROBLEM NO. 18

By J. A. W. Hunter



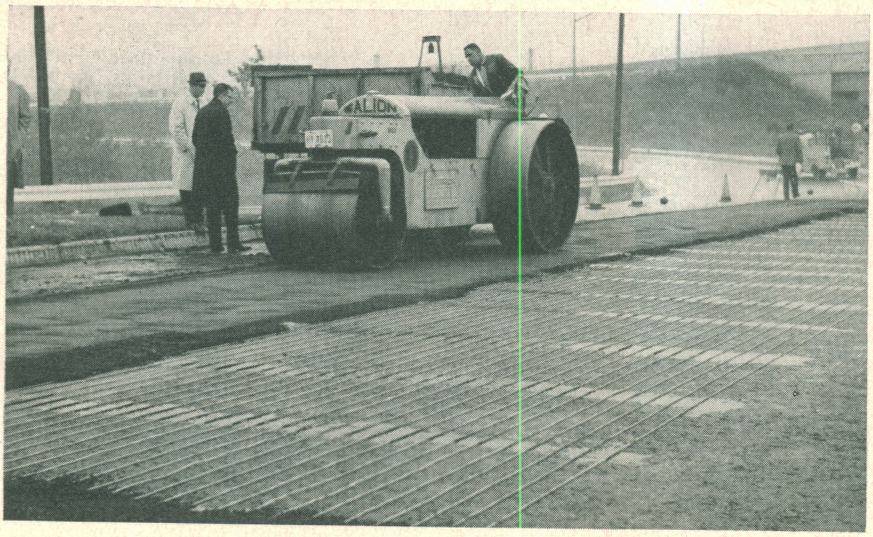
White (6 men): K on Q1, Q on QR8, Ns on QB4 and K6, and Ps on Q3 and KB5.

Black (4 men): K on Q4, R on QB3, and Ns on QN6 and KB2.

White to play and mate in three moves.

Economy Surveying Instruments

A series of surveying instruments for the small contractor, farmer, and do-it-yourself homeowner is now produced by Keuffel & Esser Company, Third and Adams Streets, Hoboken, New Jersey. The new line features two transit levels, two levels, and related accessory equipment priced below the standard K&E line of precision instruments. This series offers faster and



Sealing Heat-conducting Cables in Surface of Roadway

more economical leveling, plumbing, aligning, and layout than is possible with tape, plumb, and string methods. The models include the No. 5158 level and the No. 5159 transit-level. Each is made of die-cast aluminum and has 6-inch, 10x telescopes with micrometer focusing, and wide field of view with 3½-foot minimum focus. Accessory equipment includes a leatherette carrying case with shoulder straps, plumb bob, and simplified instruction manual.

Pavement Heating Experiment

The New Jersey State Highway Department has prepared a test site on the 5-lane Route U. S. 1 and 9 (Truck) Passaic River Bridge and its west approaches, over which 42,000 vehicles a day travel to and from New York City. The test will consist of a winter-long study on the feasibility of heating roadway pavements electrically to keep them free of ice and snow. The test area is completely exposed to severe weather conditions.

The test site is 840 feet long and covers the two 10-foot-wide eastbound traffic lanes. The physical installation on the roadway has been done in conjunction with a bituminous concrete resurfacing of the bridge deck and approaches.

The work was conducted on two weekends during the early hours of the morning when traffic volume on the highway was at its lowest ebb. A 1½-inch bituminous concrete leveling course was laid, and heat-conducting cables were positioned. Each heating unit consisted of 1,420 feet of single-conductor heating wire with suitable lengths of cold conductor connected to each end. The cold conductors were laid in a 4- by 6-inch slot cut across the concrete roadway to bring them over to the sidewalk for connection to the electrical distribution panels. The cables were sealed in proper position by applications of joint filler compound at 4-inch intervals. A ½-inch cover of sand-mix asphalt was then hand-spread over the cables and compacted with a 5-ton roller. The final 1½-inch bituminous concrete layer was then placed by a paving machine and compacted with a 10-ton roller.

Two thermocouples, one for the land-fill section and one for the bridge area, have been installed to register actual highway temperatures. Manual control is planned for the early portion of the test period, with thermostatic controls for automatic operation being planned later.

Power-Shift Transmission

New production advantages, including greater capacity, less deadweight, simplified controls, and an optional all-new "Powerflow" transmission, have been provided for the B Tournapull by the LeTourneau-Westinghouse Company, Peoria, Illinois. Because its double-acting clutches cannot engage simultaneously, the two major causes of shift-shock—gear underlap and gear overlap—have been eliminated. The remaining cause of shock, "aggressiveness," is made impossible because of the design of the unit clutch friction members.

Lubrication of the transmission is force-fed through the shafts for the bushings. Bearings and gears are fog- or mist-lubricated, which reduces the amount of oil within the case, thereby reducing the heatload common to splash or cover lubrication.

The torque converter is gear-coupled, mounted midship, and attached to the generator. It features integral sump design, and all converter fluid is full-flow filtered. Like other LeTourneau-Westinghouse torque converters, this one utilizes the Schneider system, in which the stator is stationary, thus eliminating the problem of overriding clutch.

Standard equipment includes a lock-up clutch and oil retarder. The lock-up clutch also engages automatically when the hydraulic brake is actuated, thus adding engine braking power to that of the hydraulic brake.

Award to Admiral Corradi

Rear Adm. Peter Corradi, Deputy Chief of the Navy Bureau of Yards and Docks and Civil Engineer Corps, has been named winner of the 1961 Columbo Award by the Italian-American Civic Club of Maryland, as the year's outstanding American of Italian descent. The award was presented in Baltimore on October 14. Previous winners include United States Senator John O. Pastore of Rhode Island and Judge Michael Musmanno of the Pennsylvania Supreme Court.

Professional Engineer Test Problem

Solutions and comments are invited. A solution to the problem below is published on page 54 in this issue.

P. E. PROBLEM NO. 20

The inner pipe ($ID = 1$ inch, $OD = 1.25$ inches) of the counterflow heat exchanger shown below carries 17 pounds of water per minute ($=\omega_w$) while the outer pipe carries 100 pounds of steam per minute ($=\omega_s$). What must the length of the exchanger be to heat the water to 140°F if the water enters at 50°F and the steam enters at 500°F? Assume that:

Specific heat of water

$$= c_{pw} = 1 \frac{\text{BTU}}{\text{lb.}-^\circ\text{F}}$$

Specific heat of steam

$$= c_{ps} = .5 \frac{\text{BTU}}{\text{lb.}-^\circ\text{F}}$$

Water to metal film coefficient

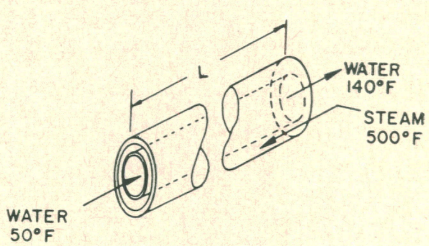
$$= h_w = 125 \frac{\text{BTU}}{\text{hr.}-\text{ft.}^2-^\circ\text{F}}$$

Steam to metal film coefficient

$$= h_s = 66 \frac{\text{BTU}}{\text{hr.}-\text{ft.}^2-^\circ\text{F}}$$

Thermal conductivity of the pipe

$$= k = 2{,}640 \frac{\text{BTU}-\text{in.}}{\text{hr.}-\text{ft.}^2-^\circ\text{F}}$$



Glass Submarines

Glass submarines, capable of navigating at depths impossible for steel submarines to reach, may be the answer to the conquest of inner space, the vast ocean depths covering 70 percent of the surface of the earth. Engineers at Aerojet-General Corporation point out that the same features which have made glass a superior material for getting man into outer space may also get him to the ocean floor. If steel of adequate thickness to withstand the deep ocean pressures were used, the submarine would sink. On the other hand, submarines made of plastic reinforced with glass fibers could be built to withstand the maximum pressures of the depths and yet be light enough to carry crew and equipment and return to the surface.

The reinforced plastic is stronger and much lighter than steel or aluminum. In addition it will not rust or corrode as metal does.

Changes in Engineer General Officers

REASSIGNMENTS

Maj. Gen. Alfred D. Starbird to Office of the Chief of Engineers.

Brig. Gen. William W. Lapsley to Division Engineer, North Pacific Engineer Division, Portland, Oregon.

RETIREMENT

Brig. Gen. David W. Heiman, September 30, 1961.

Electron and Ion Trajectory Tracer

The Hughes Research Laboratories, Malibu, California, has developed a unique form of charged-particle trajectory tracer which is being used in the design of ion engines and their neutralization systems. This trajectory tracer provides the engine designer with an accurate knowledge of ion paths during the acceleration from the ionizer to the point of exhaust of the ion beam from the engine. This knowledge of ion beam trajectories is essential to correct engine design so as to provide a laminar beam and at the same time prevent interception of ions on the accelerating electrodes. The latter requirement is vital in order to reduce erosion, which can limit the life of an incorrectly designed ion engine.

This trajectory tracer employs the principle of an analogue of the electrode structure of the engine; that is, large-scale electrodes are arranged in an electrolytic tank to form an exact scaled-up analogue of the electrodes of the gun. By suitably arranging potentials on these electrodes, electric fields can be created which are of exactly the same shape and intensity as the electric fields in the actual ion engine, including the fields due to the space charges of the ions themselves. These space charges are simulated by injecting electric currents into the water in the electrolytic tank. Four tiny wires inserted into the water and carried by a movable carriage sample the electric fields and provide input data to an analogue computer, which solves the differential equations of motion of the particle. The solutions of these equations are fed back to the trajectory tracer and servo motors move the field sampling probes along a trajectory. This trajectory is also plotted on a separate recorder to form a permanent record for use by the engine designer.

This trajectory tracer, originally developed by the Hughes Aircraft Company about seven or eight years ago for use in electron gun design, has proved to be an extremely powerful tool. It has made possible the development of ion engines with erosion rates low enough to serve on long space missions. This tracer has also been used in the design of a system for ion beam neutralization.

Welding Torch for Steel and Aluminum

A new wire-feed all-position welding torch (Model HT-1) weighing only 22 ounces has been developed by the Westing-Arc Department, Westinghouse Electric Corporation, Buffalo 5, New York. It is to provide efficient equipment for welding mild and stainless steels and aluminum in the light gages. Rated 100 percent duty cycle at 200 amps, the torch accommodates wire sizes from .030 to .047 inch. It can be used with carbon dioxide in the reactor and spray ranges, and with argon or argon gas mixtures in the reactor range. It has a nozzle-seat that allows the operator, without tools, to rotate the nozzle 360 degrees in relation to the handle.

Buckets for Wheel-type Loaders

Nine new general application buckets (three types for each of three models) have been developed for cat wheel-type loaders by Caterpillar Tractor Company, Peoria, Illinois. The new units join six earlier buckets, raising to 15 the number now offered for the 966, 944, and 922 loaders. This variety makes it possible to match capacity to the material being handled. The buckets incorporate new extended, induction-hardened, and self-sharpening cutting edges. Cast-steel corner pieces are welded to the cutting edge and to the bucket to provide maximum strength. Holes for mounting bucket teeth adapters are predrilled in buckets of the types normally used for excavation work.

Capacities for the 922, 944, and 966 standard buckets were established to provide an optimum load of 3,000 lb./yd. material, the figure generally accepted by the industry for average material. Normal rating capacity for each machine, therefore, can be determined by multiplying the standard bucket capacity in yards by 3,000 pounds.

Each of the three wheel-type loaders can now be fitted with five types of buckets now available: standard buckets, light-material buckets, reduced-capacity buckets, narrow-width buckets, and standard-width increased-capacity buckets.

Two types of special-application buckets are also available for the wheel-type loaders. Side-dump buckets can be mounted on all three. Quarry buckets with welded-type teeth are available for the two larger models. Capacities of side-dump and quarry buckets are the same as those of the standard bucket for each wheel-type loader.

Technical Pamphlets

American Iron and Steel Institute, 50 East 42nd Street, New York 42, New York—a 7-page illustrated bulletin, "Steel Shelters for Fallout Protection," listing the basic requirements for such shelters, and what one needs to know about fallout.

American Wood-Preservers' Association, 839 Seventeenth Street, N. W., Washington 6, D. C.—a 35-page pamphlet, "Wood Preservation Statistics, 1960," including information on the production activity of 359 wood-preserving plants, of which 274 use pressure processes, 57 non-pressure processes, and 28 are equipped for both types of treatment.

Army Engineer Waterways Experiment Station, Vicksburg, Mississippi—Technical Reports No. 2-571, "Navigation Conditions, Columbia Lock and Dam, Chattahoochee River, Georgia and Alabama: Hydraulic Model Investigation," price, 75 cents; No. 2-572, "Spillway, Greenup Locks and Dam, Ohio River, Hydraulic Model Investigation," price, 50 cents; No. 2-573, "Intake Studies, Dardanelle Lock, Arkansas River, Hydraulic Model Investigation," price, 75 cents; No. 2-575, "Eufaula Dam Spillway, Canadian River, Oklahoma: Hydraulic Model Investigation," price, 50 cents; No. 2-576, "Navigation Improvements in Barnhart Island - Cornwall Island Reach, St. Lawrence River: Hydraulic Model Investigation," price, 25 cents; No. 2-577, "Navigation Conditions at Pike Island Locks and Dam, Ohio River," a hydraulic investigation, price, 75 cents; and No. 6-570, "Durability and Behavior of Prestressed Concrete Beams: Pretensioned Concrete Investigation, Progress to July 1960," price, 75 cents.

Battelle Memorial Institute, 505 King Avenue, Columbus 1, Ohio—a 30-

page pamphlet, "Is There a Future Scientist or Engineer in Your Home?", to help parents and others encourage young people to prepare themselves for engineering and science courses in college.

Caterpillar Tractor Company, Peoria, Illinois—an illustrated 8-page, 2-color booklet, "Modern Perpetual Motion," covers applications of Caterpillar track-type and wheel-type loaders, defines the term, and gives seven job studies to illustrate it.

Detroit Diesel, General Motors, W. Outer Drive, Detroit 28, Michigan—an 8-page bulletin, illustrated in color, describing the development of 12 multi-fuel engines capable of utilizing any fuel from diesel #2 to combat gasoline. Potential military applications and engineering details are given.

Engineers Joint Council, 345 East 47th Street, New York 17, New York—a 24-page pamphlet, "Concerning Some Legal Responsibilities in the Practice of Architecture and Engineering and Some Recent Changes in the Contract Documents," by John R. Clark. Price, $1.00.

Euclid Division of General Motors Corporation, Hudson, Ohio—a 20-page booklet describing the complete line of Euclid equipment, including illustrations and condensed specifications on 2 models of crawler tractors, 8 scrapers, 9 rear-dump haulers, 3 bottom-dump models, and two 51-ton haulers.

Friden, Inc., 97 Humboldt Street, Rochester 2, New York — a 32-page booklet, "IDP Products in Action," presenting a data processing application involving tape-operated business machines.

Geological Survey, Washington, D. C. — a 31-page illustrated manual, "Color-Separation Scribing," the fifth volume of "Topographic Instructions of the Geological Survey," containing instructions for preparing topographic map manuscripts for multicolor printing by scribing on coated plastic sheets. Price, 40 cents, from Superintendent of Documents, Washington 25, D. C.

Keuffel & Esser Company, Third and Adams Streets, Hoboken, New Jersey — a 12-page, seven-color brochure, "Map Production with Stabilene Film," illustrating the production of modern charts and maps.

Koppers Company, Inc., Wood Preserving Division, Pittsburgh 19, Pennsylvania — a 6-page bulletin (W-365) describing fire-protected wood as a permanent, economical building material with automatic protection against fire.

The Master Builders Company, Cleveland 18, Ohio—a 48-page, illustrated pamphlet (MBR-P-3) featuring 25 reports on dams in the United States, Japan, and South America.

National Bituminous Concrete Association, 1145 19th Street, N. W., Washington 6, D. C.—a 21-page pamphlet, "Effect of Aggregate Coating on Hardening of Asphalt Cement," in which it is noted that factors other than aggregate characteristics are involved in such asphalt pavement failures as cracking and delamination.

OPW-Jordan Corporation, 6013 Wiehe Road, Cincinnati 13, Ohio—an illustrated 8-page control valve catalog (DCV-1) describing control valves of varying sizes and metals, and including pressure and temperature ratings, capacity charts, dimensions, and sample specifications.

Prestressed Concrete Institute, 205 West Wacker Drive, Chicago 6, Illinois —a 20-page booklet describing 21 different types of structures in which prestressed concrete is frequently used, with illustrations of typical units.

Society of Plastics Engineers, Inc., 65 Prospect Street, Stamford, Connecticut—a 12-page brochure, "Engineering Education in Plastics," containing a comprehensive discussion of specialized training in plastics and a description of recommended training courses.

Yeomans Brothers Company, 1999 North Ruby Street, Melrose Park, Illinois—an 8-page bulletin (Series 8000) describing vertical centrifugal wet pit pumps (Screenless). Sizes range from 75 to 1,200 gpm at heads of 10 to 75 feet. Dimensions and typical specifications are included.

Chess

The solutions to the problems on page 51 in this issue follow:

SOLUTION TO PROBLEM NO. 17

Q to K5, threatening Q-N8 mate is the key. If RxQ, P-N7 mate. If RxP check, NxR mate. If R-K1, QxR mate. If N-B3, P-N7 mate.

SOLUTION TO PROBLEM NO. 18

White's first move is K to K1. If N-QB4, N-KB4 check, K-Q5 and Q-R1 mate. If N-Q5, N-B7 check, K-B4, and Q-R3 mate. If N (at N6) to any other spot, Q-R5 check, R-B4, and QxR mate. If N-Q3, N-K3 check, K-K4, and Q-R8 mate. If N-K4, N-N6 check, K-Q3, and Q-KB8 mate. If N (at B2) to any other spot, Q-Q8 check, R-Q3 and QxR mate.

Answer to Professional Engineer Test Problem

SOLUTION TO P. E. PROBLEM NO. 20

The problem is published on page 52 in this issue.

Terms used in the solution are:

D_o = outside diameter of the inner pipe
D_i = inside diameter of the inner pipe
L = length of the heat exchanger
ΔT_A = temperature difference between steam and water at the hot water end of the exchanger
ΔT_B = temperature difference between steam and water at the cold water end of the exchanger
ΔT_w = temperature rise in the water
ΔT_s = temperature fall in the steam
Q = total heat flow per unit time from the steam to the water
U = over-all transmittance of the system
A = effective heat transfer area
ΔT_m = logarithmic mean temperature difference

The solution is obtained by use of the equations:

$$Q = UA\Delta T_m \qquad (1)$$

$$1/UA = 1/h_s\pi D_o L + 1/h_w\pi D_i L + ln\,[(D_o/D_i)/2\pi Lk] \qquad (2)$$

$$\Delta T_m = (\Delta T_A - \Delta T_B)/ln\,(\Delta T_A/\Delta T_B) \qquad (3)$$

$$Q = \omega_w c_{pw}\Delta T_w = \omega_s c_{ps}\Delta T_s \qquad (4)$$

Thus from (4):

$\Delta T_s = [(17)(90)]/[(100)(.5)] = 30.6°F$

and therefore from (3):

$\Delta T_m = (360-419.4)/ln\,(360/419.4) = 388.7°F$

From (2):

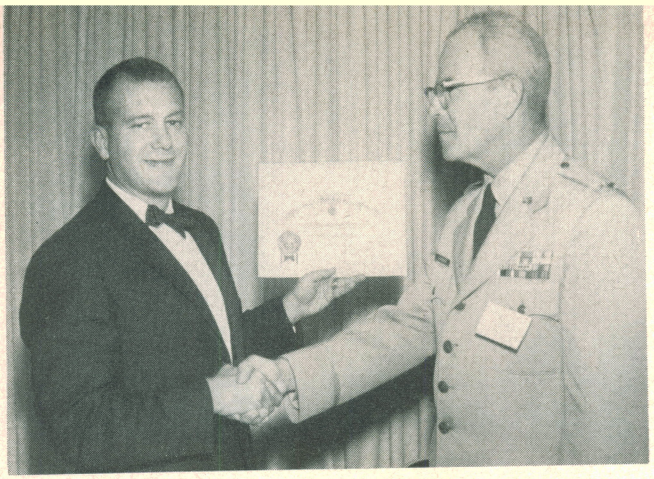
$1/UA = 1/L(12/66\pi 1.25) + (12/125(1.0)\pi) + [12ln(1.25/1)/2\pi 2640)]$
$= .0771/L$ or
$UA = 13L$

and from (1):

$(17)(60)(90) = 13\ L\ 388.7$ or
$L = 18.2$ ft.

Dredge, Frontera-I, for the Mexican Government

Manufactured by Ellicott Machine Corporation, Baltimore, Maryland, this dredge was assigned to the Port of Frontera, Tabasco, for maintaining the entrance channel to the Grijalva River. A sister unit is under construction for the Mexican Navy.



Presentations of Sustaining Membership Certificates

R. M. Williams, managing director of ARO, Inc., right, receiving the certificate from Maj. Gen. William L. Rogers, Society Director, and Lt. Col. William Langley, president of the Tullahoma Post, left.

Comdr. D. W. Wildfong of Temco Electronics & Missiles Company, left, receiving the certificate for his company from Col. Adolf Kroeber, president of the Dallas Post of The Society.

HONOR ROLL OF SUSTAINING MEMBERS

As an indication of their interest in the activities of The Society of American Military Engineers and to assist in maintaining and extending its program to increase the engineering potential of the United States for National Security and to support the many other activities designed to advance the science and art of military engineering, the following companies have become Sustaining Members of The Society.

AETRON—Covina Plant, Division of Aerojet-General Corporation, Covina, Calif.
Principal—Benjamin F. Rose, Jr.
Alternate—Marshal A. Beck

AMCO Electric, Altadena, Calif.
Principal—Leo Schilz
Alternate—Leon Chereshkoff

American Dredging Company, Philadelphia, Penn.
Principal—Maylin H. Greaser
Alternate—August D. Pistilli

ARO, Inc., Arnold A. F. Station, Tenn.
Principal—B. H. Goethert
Alternate—A. J. Moore

The Arundel Corporation, Baltimore, Md.
Principal—John A. Reilly
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Atlantic, Gulf & Pacific Company, New York, N. Y.
Principal—H. F. Schoon
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Basalt Rock Company, Inc., Napa, Calif.
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Leo A. Daly Company, Omaha, Nebr.
Principal—Leo A. Daly
Alternate—John M. Free

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Earl and Wright, Inc., San Francisco, Calif.
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Alternate—J. G. Wright

Holyoke Water Power Company Holyoke, Mass.
Principal—Robert E. Barrett, Jr.
Alternate—Robert H. Walker

Kentucky Utilities Company, Lexington, Ky.
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Founded January 1, 1920 — Incorporated December 5, 1924

Constituent Member of Engineers Joint Council

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1962

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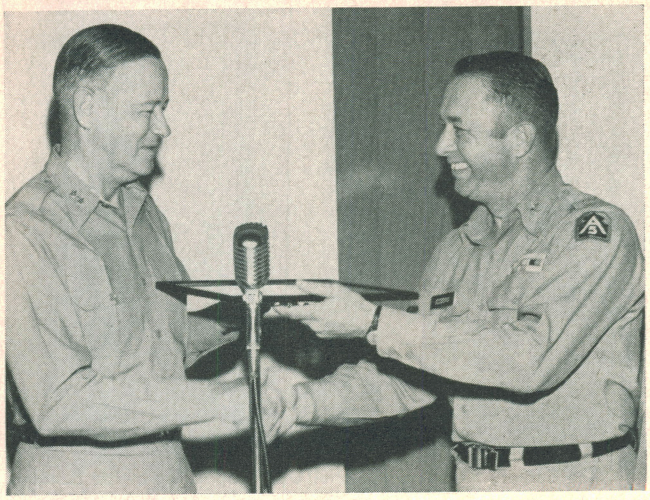
Warren S. Mann, Vice President, Armco Drainage & Metal Products Company, Middletown, Ohio.
Maj. Victor V. Martin, A. U. S., Retired, Washington, D. C.
Maj. Gen. William L. Rogers, Commander of the Arnold Engineering Development Center, U. S. Air Force, Tullahoma, Tenn.
Brig. Gen. Herbert D. Vogel, U. S. Army, Retired; Chairman of Board, Tennessee Valley Authority, Knoxville, Tenn.
Lt. Gen. Raymond A. Wheeler, U. S. Army, Retired; Engineer Consultant, International Bank for Reconstruction and Development, Washington, D. C.
Lt. Gen. W. K. Wilson, Jr., Chief of Engineers, U. S. Army, Washington, D. C.

1963

Rear Adm. Leo Otis Colbert, U. S. Coast and Geodetic Survey, Retired, Washington, D. C.
Rear Adm. James R. Davis, U. S. Navy, Public Works Officer, 11th Naval District, San Diego, Calif.
Lt. Col. Leslie J. Fanshaw, U. S. Army, Office, Chief of Engineers, Washington, D. C.
Rear Adm. H. Arnold Karo, Director of the U. S. Coast and Geodetic Survey, Washington, D. C.
Col. L. L. Lessig, Bethlehem Steel Company, Retired, Philadelphia, Penn.
Maj. John W. Leslie, Chief, Engineering Division, New England Division, Corps of Engineers, Boston, Mass.
Rear Adm. Robert H. Meade, U. S. Navy, Retired; Consultant, Parsons, Brinckerhoff, Quade & Douglas, New York, N. Y.
Maj. Gen. George J. Nold, U. S. Army, Retired; Skidmore, Owings, and Merrill, New York, N. Y.
Rear Adm. Cushing Phillips, U. S. Navy, Retired, San Francisco, Calif.
Capt. Spencer R. Smith, Civil Engineer Corps, U. S. Navy, Assistant to the Chief, Bureau of Yards and Docks, for Military Personnel, Washington, D. C.

1964

George H. Beard, Vice President and Omaha Branch Manager, Layne-Western Company, Omaha, Nebr.
Donald C. Bentley, Partner, Bentley Engineers, San Francisco, Calif.
Col. John H. Carruth, U. S. Army, Retired, 241 Claywell Drive, San Antonio 9, Tex.
Frank K. Gayle, Chief of the Estimates Sec., Engr. Div., Baltimore Engineer District, Md.
Gen. Franklin A. Hart, U. S. Marine Corps, Retired; Vice President and Director, Porter International Company, Washington, D. C.
James L. Ingram, Ingram Construction Company, Jacksonville, Fla.
Col. Francis K. McGinnis, Jr., Deputy Chief, Engr. Div., Office, U. S. Air Force Civil Engineering Representative, Southwest Region, Dallas, Tex.
Brig. Gen. Roy T. Sessums, U. S. Air Force Reserve, Assistant Vice President, Freeport Sulphur Company, New Orleans, La.
Hanford Thayer, Project Engineer, Seattle Engineer District, Seattle, Wash.



Presentations of Society Certificates of Appreciation

Brig. Gen. Richard L. Jewett, right, Far Eastern Representative of The Society, 1959-1960, receiving the certificate from Col. T. H. Setliffe, Philadelphia Post president. Capt. R. A. Bosee is at left.

Maj. Gen. Howard Ker, left, Middle European Area Representative, 1959-1960, receiving the certificate from Maj. Robert W. Kiddoo, first vice president of the Fort Leonard Wood Post of The Society.

Society Conferences

Southwestern Regional Conference, at El Paso, Texas, February, 21-24, 1962.

Midwestern Regional Conference, pending, April 1962.

Western Regional Conference, at Seattle, Washington, July 13, 1962. Benjamin Franklin Hotel, M. C. Falconer, general chairman.

Northeastern Regional Conference, pending, October 1962.

Southeastern Regional Conference, at Charleston, South Carolina, November 1962.

42nd Annual Meeting

The Annual Meeting will be held at Washington, D. C., May 21-22, 1962, at the Mayflower Hotel.

May 21

The program for the first day will comprise morning and afternoon sessions devoted to the Symposium, "Engineering for Space." At the luncheon on that day a short business meeting will be held and the new officers of The Society for the year will be inducted.

In the evening there will be a social hour followed by a gala Military Engineer Dinner, at which the annual awards of The Society will be presented.

May 22

A morning session continuing the symposium will be held, followed by a luncheon at which James E. Webb, the Director of the National Aeronautics and Space Administration, will be the guest speaker.

SYMPOSIUM

Wide interest has been shown in the plans being made for the symposium which is expected to present comprehensive coverage of the theme: "Engineering for Space."

At the morning and afternoon sessions of May 21 and on the morning of May 22, papers will be presented by representatives of the following industrial firms and Armed Forces Engineer services:

AETRON Division, Aerojet-General Corporation
ALCO Products, Incorporated
Allis-Chalmers Manufacturing Company
American Machine & Foundry Company
American Telephone and Telegraph Company
Detroit Diesel Engine Division of General Motors Corporation
Douglas Aircraft Company, Incorporated
General Dynamics Corporation
General Electric Company
Litton Industries, Incorporated
The Martin Company
Melpar, Incorporated, Division of Westinghouse Air Brake Company
National Aeronautics and Space Administration
North American Aviation, Incorporated
Radio Corporation of America
U. S. Steel Corporation
Westinghouse Electric Corporation
Army Corps of Engineers
Navy Civil Engineer Corps
Air Force Directorate of Engineering
U. S. Coast & Geodetic Survey
U. S. Coast Guard Engineers

Exhibits by a number of the participating companies and by the Army, Navy, and Air Force engineers will be on display at the meeting.

Southwestern Regional Conference

EL PASO—FEBRUARY 21-24, 1962

The El Paso Post, Harry H. Corbett, president, will be host to the Regional Conference, February 21-24, 1962, in El Paso, Texas, with Glenn English and Col. R. A. Kohloss, Jr., as general conference co-chairmen. The conference committees are: Cols. Edwin Rubenstein, Harold Bisbort, Paul Lance, and James Laird, technical program; Stephen Kent, attendance; Col. Lawrence Adams, promotion; Harry Corbett and Col. Walter Parsons, budget and finance; Maj. Robert Nelson, reception; John Foster and John Josey, advertising; Lawrence Wood, registration; and Mrs. Glenn English, Mrs. Walter Parsons, Mrs. Douglas Parham, and Mrs. Stephen Kent, entertainment.

PROGRAM

February 21.—Demonstration, a.m., at Biggs Air Force Base (SAC), of readiness and effectiveness of Air Force defense power. (Preliminary for early arrivals.)

February 22.—Registration 2 to 5:30 p.m. at Hotel Cortez; social hour, 6:30 p.m.

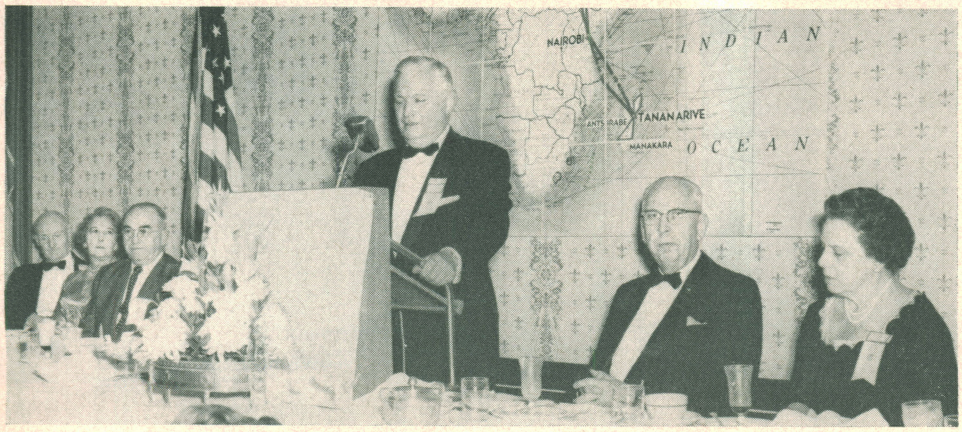
February 23.—Hotel Cortez, 9 to 11 a.m., welcome and technical sessions; 12:15 p.m., luncheon followed by technical sessions 2 to 4 p.m.

Hotel Hilton, 7 p.m., joint banquet with Texas Society of Professional Engineers. Col. Walker L. Cisler, guest speaker.

LADIES PROGRAM: Tour El Paso and Juarez (a.m.); luncheon and style show at the International Club, El Paso; social hour and dinner, Gay 90's Club, 6:30 p.m.; and "Blithe Spirit," by Noel Coward, Little Theatre, 8:30 p.m.

February 24.—Ranchero breakfast, Hotel Cortez; luncheon and horse racing, 1:30 p.m., Sunland Park. Evening: Closing ceremonies, dinner dance, and entertainment at La Fiesta Dinner Club, Juarez, Mexico.

Among the prominent members and guests expected to attend are Rear Adm. Joseph F. Jelley, Society Vice



The Society President, Colonel Cisler, Speaking at the Banquet of the Southeastern Regional Conference in Savannah

L to r, Col. Raymond Hill, Mrs. James Ingram, Col. F. H. Kohloss, Colonel Cisler, Burton J. Bell, and Mrs. Kohloss.

President for the region; Maj. Gen. Robert J. Fleming, Army Division Engineer, Southwestern Division; Brig. Gen. Roy T. Sessums, New Orleans, and Cols. John H. Carruth, San Antonio, and Francis K. McGinnis, Dallas, Society directors; Col. John F. Arfman, Albuquerque; Col. C. Paul West, Fort Worth; Col. Howard W. Penney, Tulsa; Col. John C. Dalrymple, Little Rock; and Lt. Col. J. S. Maxwell, Galveston.

Representatives of the Army Chief of Engineers, Navy Chief of Civil Engineers, Air Force Civil Engineers, and U. S. Coast and Geodetic Survey are expected to participate in the program.

Southeastern Regional Conference

Some 185 members and guests registered for the Southeastern Regional Conference held November 10-11, 1961, at the DeSoto Hotel, Savannah, Georgia.

Col. Raymond L. Hill, president of the Savannah Post, presided at the morning session of November 10, at which Savannah Mayor Malcolm R. Maclean welcomed The Society and Burton J. Bell, Society Vice President for the region, responded. Morning speakers included Maj. Gen. Lief J. Sverdrup of St. Louis, who described his experiences in the Southwest Pacific in World War II; and Brig. Gen. Austin W. Betts, who compared continuing nuclear testing with cessation of all such tests.

The Savannah District Engineer, Col. W. A. Stevens, who presided at the luncheon meeting, introduced Brig. Gen. H. A. Morris, Southeastern Division Engineer, who traced the development and work of the Southeast River Basin Study Commission of which he is a member.

The afternoon session was presided over by Brig. Gen. Paschal N. Strong. Speakers included Rear Adm. Norman J. Drustrup, Director of Atlantic Division of Bureau of Yards and Docks, who outlined the far-flung international network of Navy construction activities; and Col. F. H. Kohloss, executive secretary of The Society, who described Society activities and current operations.

A social hour was followed by the evening banquet, at which Col. Walker L. Cisler, president of The Society, spoke on his recent 30,000-mile visit to Russia, Madagascar, North Africa, and other areas. A dance concluded the evening program.

The program for November 11 included an inspection of the harbor activities and participation in the local Veterans Day celebration.

The ladies' program on the first day included a tour of the historical points of the city, with a special coffee hour at the famed Owens-Thomas House.

Representatives from the following posts attended: Atlanta, Canaveral, Charleston, Detroit, Fort Belvoir, Fort Bragg-Fayetteville, Huntsville, Jacksonville, Mobile, New York City, Norfolk, Savannah, St. Louis, South Florida, and Washington, D. C.

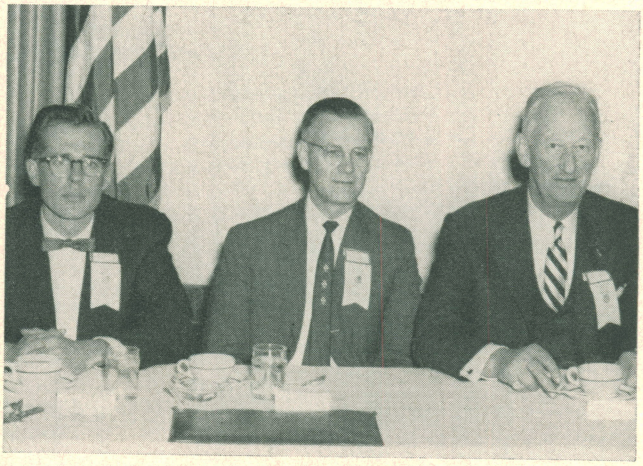
New Director

Maj. Gen. William L. Rogers, Commander of the Arnold Engineering Development Center, U. S. Air Force, Tullahoma, Tennessee, has been elected as a Director of The Society by the Board of Direction to fill the vacancy created by the death of Richard E. Dougherty in September. General Rogers' term will run until the next annual election of officers.

William L. Rogers was born in Larchwood, Iowa. After attending the University of South Dakota for a year, he entered the U. S. Military Academy, and graduated in 1934. In 1939 he received a Master of Science degree from Cornell University.

From 1944 to 1945, with the rank of lieutenant colonel, he commanded the 1141st Engineer Combat Group in Europe and for the next two years the 346th Engineer General Service Regiment in Germany.

Colonel Rogers transferred to the Air Force in 1947. Following two



Speakers at the Morning Session and Luncheon, Savannah

Brig. Gen. H. A. Morris speaking at the luncheon, with Burton J. Bell and Col. W. A. Stevens seated at left.

Rev. W. B. Reinhardt, Brig. Gen. A. W. Betts, and Maj. Gen. Lief J. Sverdrup, who participated in the morning program.

Officers at the Memphis Southeastern Regional Conference

L to r: Rear Adm. W. C. G. Church, Assistant Chief of the Navy Bureau of Yards and Docks; Colonel Cisler, Society president; Maj. Gen. T. A. Lane, Division Engineer, Lower Mississippi Valley; Col. F. H. Kohloss, Society executive secretary; and Col. M. L. Jacobs, Memphis Post president.

years of duty at Offutt Air Force Base, Nebraska, and Fort Benjamin Harrison, Indiana, he attended the Air War College. He then was assigned to Headquarters MATS in Washington, D. C., serving as Chief of Air Installations, Directorate of Materiel, and as Deputy Director, Materiel, from 1951-1952. He was successively Deputy Chief of Staff, Materiel, at Headquarters Air Research and Development Command in Baltimore, Maryland; and Assistant for Development Programming with the Deputy Chief of Staff, Development, at Headquarters U. S. Air Force in Washington, D. C., reaching the rank of brigadier general in 1956. In March 1958 General Rogers became Vice Commander of the Air Force Missile Test Center, Patrick Air Force Base, Florida. In March 1961 General Rogers was promoted to the rank of major general, and in June was given his present assignment.

Eugene Reybold 1884-1961

Lt. Gen. Eugene Reybold, U. S. Army Retired, who was the Army Chief of Engineers throughout World War II, died on November 21, 1961. General Reybold was Chief of Engineers from October 1941 until October 1945 and was retired from active service on January 31, 1946.

From 1950 to 1956 General Reybold served as Executive Vice-President of the American Road Builders Association, Washington, D. C., where his long service as builder and administrator in the Army made possible significant contributions by him to the advancement of highway construction and improvement in this country. Since that time, he had operated a consultant service in Washington.

General Reybold was born at Delaware City, Delaware, and was a civil engineering graduate in 1903 of the old Delaware College, now the University of Delaware. He joined the U. S. Engineer Department as a civilian assigned to river and harbor work, and after five years of service, received a second lieutenant's commission and entered the Coast Artillery. At the end of World War I he held the temporary rank of colonel. He then reverted to his permanent rank of captain. He transferred to the Corps of Engineers in 1926, and served through all the grades to lieutenant general and to the highest post in the Corps of Engineers.

Throughout his service he held a variety of important assignments including Commandant of the Coast Artillery School, and Constructing Quartermaster supervising construction at several other posts in Virginia, including Langley Field and Camp Eustis; instructor at the General Service Schools, Fort Leavenworth; District Engineer, Buffalo, New York, and Memphis, Tennessee, where he successfully directed weeks of battle against record Mississippi River flood crests. In mid-1937 General Reybold, with the title of Division Engineer, was ordered to Little Rock, Arkansas, to organize the Corps of Engineers Southwestern Division. He became Acting Assistant Chief of Staff, Supply Division, on the War Department General Staff in 1940, and in 1941 he was assigned to the Office of the Chief of Engineers as Acting Chief, succeeding to the Office of Chief of Engineers in that year.

He was a graduate of the Coast Artillery School, the Command and General Staff College, Fort Leavenworth, and the Army War College. He held the degree of Doctor of Engineering from the University of Delaware; and Doctor of Science degrees from the University of Arkansas and Drexel Institute of Technology. He was a Military Engineer Member of The Society for 34 years and an active supporter of it throughout his service.

Deceased Members

It is with sincere regret that The Society has learned of the death of the following members, to whose bereaved families deepest sympathy is extended:

Donovan D. Anderson, Dixon, Ill.; Lt. Col. Myron R. Bittikofer, Sacramento, Calif.; Fletcher H. Burke, Coral Gables, Fla.; Percy Canaday, Greensboro, N. C.; Michael P. Casale, Williamsport, Penn.; Maj. James A. Casburn, San Antonio, Tex.; James G. Clarkson, Denver, Colo.; William R. Daniels, Yuba City, Calif.; Joseph A. Diehm, Flushing, N. Y.; Richard E. Dougherty,** New York, N. Y.; Col. William D. Eister, A.P.O., San Francisco, Calif.; Joseph A. Gallagher, Sr., Los Angeles, Calif.; James F. Gominger, South Amboy, N. J.; Benjamin Govern, Brooklyn, N. Y.; Arthur W. Hoag, Burlington, Vt.; Donald T. Holmes, Chester, Penn.; Lt. Comdr. Thomas F. Holz, Warrington, Penn.; Robert B. Jackson, Toronto, Canada; Richard E. Krueger, Denver, Colo.; Charles Leopold, Philadelphia, Penn.; Charles J. McMurray, New York, N. Y.; Charles R. Mullen, A.P.O., San Francisco, Calif.; Capt. Owen B. Neff, Ft. Belvoir, Va.; Lt. Gen. Eugene Rey-

**Obituary in preceding issue, page 476.

Col. M. L. Jacobs, Memphis Post President, Addressing the Southeastern Conference

L to r: Robert E. Hagenhoff, general chairman; Mrs. Paul E. Gieselmann; Burton J. Bell, vice president for the Southeastern Region; Mrs. M. L. Jacobs; Maj. Gen. T. A. Lane; Col. Walker L. Cisler, President; Colonel Jacobs; Mrs. Hagenhoff; Col. F. H. Kohloss, executive secretary; Adm. William C. G. Church; and Mr. Gieselmann, program chairman.

bold, Washington, D. C.; Comdr. Don C. Ritchie, Arlington, Va.; Lt. Col. Colin C. Simpson,* Great Neck, N. Y.; Capt. Robert H. Tompkins,* Corpus Christi, Tex.; Robert H. West, Lombard, Ill.; Maj. Arthur G. Wilson, Chicopee Falls, Mass.; Raymond W. Wise, Fremont, Ohio.

Membership Awards

The following members recently have received the awards indicated in recognition of their efforts and success in extending The Society's membership.

(The awards are The Society Plaque for obtaining 100 or more new members; the Certificate of Merit for 50 or more; Desk Ornament for 25 or more; Silver Medal for 10 or more; Silver Emblem for 3 or more.)

SOCIETY PLAQUE WINNER

Maj. Herbert V. Larson.

CERTIFICATE OF MERIT WINNERS

George C. Abel and Joseph A. Benoit.

DESK ORNAMENT WINNERS

Harold Dixon, Silas C. Stoddard, Maj. Louis O. Tibbs, and Carl Wesley, Jr.

*Charter Members.

SILVER MEDAL WINNERS

Carlton M. Archibald, Lt. Col. Aldo Artiglia, Lt. Col. Charles H. Bergmann, Jr., Robert R. Burrell, Comdr. Adrian C. Dawson, Francis C. Dickinson, E. M. Garrett, Lt. Col. Rodgers L. Gregory, Francis C. Hastert, Maj. David S. Hatcher, Capt. Edgar B. Hickey, Maj. William W. Higbee, Comdr. Walter R. Jenkins, Warren C. Johnson, Col. James W. Kimsey, Alexis B. Kononoff, Col. Robert I. Millberry, Frank P. Minutillo, Alf A. Oldfield, Lt. Col. Henry K. Shane, Col. Sherwood J. Stacy, Capt. Victor O. Trevino, and John M. Van Wettering.

SILVER EMBLEM WINNERS

Robert L. Acklen, Jr., Lt. Col. Frank M. Albosta, Donald L. Archibald, Joaquin Arguelles, Joseph Bechtold, Anthony A. Benish, Robert J. Botsko, James R. Bowen, Price E. Britt, Maj. Ralph E. Bush, Lt. Col. Theo. J. Combel, Jr., James E. Creel, Benefrido M. Cruz, Lt. Comdr. Donald F. Dalton, Capt. J. Henry Etter, Edward M. Faber, Lt. Thomas P. Faulconer, Nathaniel Feiner, Francis P. Ferriter, George E. Fox, Gilbert S. Frankel, Lt. Col. John M. Frassrand, Raymond E. Gaugler, Julian A. Gerber, Jack C. Goldthorpe, Capt. John W. Gordanier, Capt. Clifford N. Hanson, Col. Robert B. Harrison, William G. Haun, Capt. Walter P. Hayes, Donald E. Heintzelman, Lt. Comdr. George O. Helms, Capt. George H. Hilt, Thomas L. Hodges, Lt. Donal D. Hogan, Lt. Col. John J. House, H. W. Howarth, Capt. Merrill E. Jensen, Col. Harry A. Johnson, Capt. Tom R. Johnson, Thomas L. Kilby, Comdr. Kenneth M. Klein, Vaughn D. Knight, Lt. Maxim I. Kovel, Lt. George R. Landis, Brian W. Lays, Harvey B. Leaver, Lt. Maurice B. Levien, Hilliard H. Lewis, Jack C. Lipman, D. K. Lontos, Joseph Markle, Jack A. McCann, Capt. Neil O. McCray, Capt. Franklin O. Mikle, Maj. Gen. A. M. Minton, Daniel J. Morrow, Paul A. Mueller, Joseph P. Nicoletti, Martin H. Noonan, John P. Olson, Capt. Kathleen R. O'Rourke, Maj. Raymond J. Pflaum, Capt. Donovan B. Poe, Anthony C. Psota, Stephen S. Purdy, Lt. Robert R. Randall, Col. Andrew P. Rollins, Jr., Reginald J. Saunders, Roland J. Simpson, Harold F. Sitts, Raymond J. Stoll, Raymond W. Stone, Lt. Alexander Surko, Jr., Ralph S. Swanson, Sturtevant Todd, Edward B. Trueworthy, Jr., Ernest W. Ubert, Jr., Maj. Jack A. Vaira, Brig. Gen. Samuel T. Wallace, Richard F. Wherry, Capt. Robert L. Woolbright, Capt. George D. Young, and Lt. Col. Roger L. Young.

Local Post Work for Engineering Progress, 1960-1961

A summary of the activities of Local Posts during 1960-1961 reveals the deep sense of obligation Society members have toward their community, their profession, and toward the generation that will produce the engineers of tomorrow.

Community Relations

In overseas posts, Society engineers have found exceptional opportunities for contributing their technical skills to community improvement. This year special ceremonies at the *Okinawa Post* attested the gratitude the villagers of Katsuren-son feel toward the late Eugene H. Herrick, for his assistance in developing the village water system and for his efforts to acquaint the Ryukyuan people with American culture. The water system is to be named after Mr. Herrick, and a monument to him will be erected on the site. A testimonial letter from the villagers was presented to Mrs. Herrick at a meeting of the *Albuquerque Post.*

The *Tehran Post* reports that the preparation of plans and specifications for the new addition to the Dreyfus Clinic is completed, except for minor details. In the Pacific Area, Comdr. W. F. Kopfler, former president of the *Manila Post,* has been awarded the Degree of Officer of the Philippine Legion of Honor, in recognition of his services to the Philippine construction industry. Early this year, the *London Post* contributed $100 to the relief fund for the Six Bells Colliery Disaster, in which 45 miners lost their lives.

In this country, the *Huntington Post* is planning a series of meetings on civil defense, to which interested groups in the area will be invited. The *Lehigh Valley Post* is creating a Citizens' Committee for Lehigh Valley Regional Planning, to co-ordinate planning by the cities, boroughs, and townships in the valley. A series of programs has been sponsored by the *Pikes Peak Post,* to give military and civilian engineers in the region an opportunity to discuss techniques and progress in their fields. A television program describing the development and successful firing of the Polaris missile was sponsored by the *San Francisco Post.*

Technical Assistance

The *Portland Post* participated in the Governor's Committee on Science, Engineering, and New Technologies, which is appraising the scientific resources and manpower of the State, to see how they may best contribute to the advancement of knowledge, economic development, and the national security. The *Los Angeles Post* is providing technical assistance to the local Office of Civil Defense. The *Central Texas Post* met jointly with the local chapter of the Texas Society of Professional Engineers to consider problems of water conservation in the region.

The *Okinawa Post* reports that technical assistance has been given to local engineers on such problems as drainage, water supply, surveying, and installation of factories. At the request of the Chief Executive of the Islands, a study of the construction of typhoon-resistant, termite-free, low-cost housing was prepared in Japanese. It covers construction of farmhouses, suitable architecture for the island, and problems of termite damage and control, and suggests legislation to enable the government to support the program. The Civil Administrator of the Islands has commended post members for their contribution to the integrated water development program.

The *Tokyo Post* is holding a photography contest to record and disseminate knowledge of Japanese construction tools and engineering expedients that might be adopted profitably in other countries. Prizes will be awarded for the best photographs of indigenous construction methods, tools, and materials that have some application to military engineering.

The *Galveston Post* has undertaken to assist eligible candidates to prepare for the professional engineer licensing examination by conducting review courses; and to promote acceptance of professional experience by state licensing boards.

Scholarships

Sixteen posts are currently offering scholarships to promising engineering students. In the Pacific Area, three posts have taken a passage from the Bible as a foundation for the establishment of scholarships. From Luke 12:48, it reads: "For unto whomsoever much is given, of him shall much be required." The *Oahu Post** provides two scholarships to the University of Hawaii; the *Subic Bay Post** sponsors programs at the Mapua Institute of Technology and the Naval Reservation College; and the *Guam Post** is sponsoring a scholarship program at the University of the Philippines. The *Guam Post* program is primarily a "people to people" project to develop the professional engineering talent among citizens of the Marianas and Marshall Islands. As such, the post not only offers university scholarships, but pays all the expenses for several candidates to complete a one-year engineering preparatory course at the Territorial College of Guam before entering the university. The *Oahu Post* program is designed to encourage competent young engineers to take up military engineering as a profession, and incidentally to encourage establishment of a Society student post at the University of Hawaii. The *Subic Bay Post* project is intended to give Philippine students an opportunity to obtain an engineering education. Now sponsoring two scholarships, the post will establish a third (for graduate studies) when it has built up its membership sufficiently to be able to support all three scholarships on a continuing basis.

Elsewhere overseas, the *Frankfurt Post* has awarded a DM 1,000 ($238) scholarship to a German engineering student. The *Korea Post* has selected two students to receive scholarships to the Seoul National University. The *Okinawa Post* now sponsors seven Okinawan students at the University of the Ryukyus, and recently presented a check for $750 to Dr. Genshu Asato, president of the university, to further the education of engineering students. And the *Tehran Post* has provided funds for an Iranian student to continue his education at Roberts College in Istanbul. The value of all these projects is twofold, in that they make substantial contributions to international goodwill at the same time that they enrich the profession.

In this country, the *Boston Post* now awards two $500 scholarships. The *New York City Post* has had a flourishing scholarship program for years, and this year presented $200 scholarships to thirteen outstanding ROTC cadets, all members of student posts of The Society, at six colleges in the metropolitan area. The post holds a dinner dance each fall to finance the scholarship funds. The *Fort Worth, Minot,* and *Riverdale Posts* also awarded scholarships to engineering students this year. The *Anchorage, Central Texas, San Antonio,* and *Omaha Posts* are making final arrangements to initiate scholarship funds. The vice president of the *Omaha Post,* Willard A. Richardson, has arranged for his firm, Henningson, Durham, & Richardson, to contribute $150 a year to the post scholarship fund. The *Polaris Post,* in a particularly interesting project, presented a check for $300 to the University of Alaska to be used as a reserve fund for engineering and scientific students to attend authorized engineering or scientific meetings.

A Sloan Fellowship for a year's study at the Massachusetts Institute of Technology has been awarded to Claude J. Farina, a member of the *Sacramento Post.*

Youth Programs

The interest local posts take in attracting young people to careers in science and engineering is evinced in the number of contests and awards sponsored, and in the constant efforts being made to acquaint potential engineers with the profession.

Contests and Awards

In the spring of 1960, the *Canaveral Post* sponsored a competition based on the theme "Scientific Thinking and Development in the Interests of Future Americans" at the Brevard County Science Fair, with particular emphasis being given to missiles and space exhibits. The grand prize was awarded to Kipp Heintzelman, then an eighth grade student, for his instrumented Mercury Capsule and Kinetic Instrumentation Programmer. The post also sponsored the appearance of the winners and demonstrations of their exhibits on television.

The *Fort Belvoir Post* sponsored its Third Annual Science Fair this year in collaboration with local grade schools; and the *Walla Walla Post,* together with the Mathematical Association of America and the Society of Actuaries, sponsored its annual mathematics contest for high school students. This post also offers a medal to the senior student at the Washington State University who has the most outstanding record of participation in Society activities.

The *Heidelberg Post* awards a $100 U. S. Savings Bond to the American high school student who best meets established criteria for leadership and engineering scholarship. The *Los Angeles Post* this year presented Certificates of Merit to seven outstanding engineering students from four local universities. The *Mobile Post* awards a citation and shoulder cord to the most outstanding sophomore in the engineering course at Auburn University. A year's membership in The Society and in the post accompanies the $100 prize offered by the *Oahu Post* to the outstanding senior student in the College of Engineering at the University of Hawaii.

Advancing the Profession

In an effort to assist high school students interested in college courses in science and engineering, the *Batlimore Post* has decided to affiliate with the Engineer Council for Professional Development to distribute appropriate materials throughout the high schools in the area. The *Denver Post* sponsored a program of technical reports for student post members at the Colorado School of Mines and the University of Colorado. One of the cadets contributing to the program read his paper at a post meeting, and was awarded a Government Savings Bond in recognition of his excellent work. The *El Paso Post* invited Texas Western College student post members to a discussion of the importance of the liberal arts as a part of engineering education. The *Huntsville Post* was host to 30 high school students interested in engineering careers at a meeting to discuss various fields in engineering. This post has also provided speakers for educational symposia in local high schools. A committee has been formed at the *Mississippi Gulf Coast Post* to discuss career possibilities in various engineering fields with educators and high school students. The *Portland Post* invited the vocational counselor of a local high school and two senior students to discuss an accelerated teaching program for engineering and science students. The *Jacksonville Post* has endorsed establishment of Cadet Training Corps Engineering Units in city and county high schools, and will assist in their sponsorship and support. The *Tulsa Post* invites senior high school students to post meetings and afterwards conducts them on a tour of the Tulsa District Office. The *Wiesbaden* and *Fort Belvoir Posts* sponsor Boy Scout Troops. The *Austin Post* held a joint meeting with the University of Texas Student Post, with the president of the student post presiding. The *Philadelphia Post* invites student post members in the area to all post meetings.

These are only a few of the activities undertaken by local posts to advance the standing of engineering as a profession and to increase the national security. The National Headquarters congratulates each post on its fine accomplishments and initiative, and looks forward to another year of achievement with confidence and anticipation.

*See Post News, pp. 66, 68, 71.

Local Posts

MEETINGS • EVENTS • OFFICERS

★ ★ DISTINGUISHED LOCAL POSTS, 1960 ★ ★

BALTIMORE POST COASTAL BEND POST NEW YORK CITY POST

PHILADELPHIA POST SAN FRANCISCO POST

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All members of The Society who are not members of Local Posts, and who live at places where attendance at Local Post meetings is practicable, are urged to write to the secretary of the nearest Post and apply for membership. These Posts are organized under individual constitutions and by-laws which authorize them to impose Post dues, to decide upon membership, and to set up requirements not inconsistent with the approved constitutions and by-laws.

ABILENE

At the meeting of September 28, Maj. Jack Lambert gave an interesting lecture, with slides, on the part played by the Corps of Engineers in the Atlas Missile construction at Dyess Air Force Base.

ATLANTA

Capt. John P. Jones, Range Safety Officer, Cape Canaveral Missile Test Annex, Patrick Air Force Base, was the speaker at the October 12 meeting, held jointly with the Georgia Section, American Society of Civil Engineers. Captain Jones discussed "Aerospace Activities at Cape Canaveral."

BALTIMORE

At the meeting of September 20, Charles K. Hurst, Harbors and Rivers Engineering Branch, Department of Public Works, Canada, spoke on "Blue Tags and Red Tape," giving a detailed account of the economic and political phases of harbor and river projects in Canada. Major projects discussed were the blasting of Ripple Rock[1] in Vancouver Sound ship channel; dredging of sand infiltration in St. John's Harbor; the use of chemicals for protection of harbor and river installations against ice damage; and employment of Indians on dredging projects. Mr. Hurst, as Canadian delegate to the Permanent International Association of Navigation Congresses, also related the activities of the XXth PIANC Congress.

Guest speaker at the meeting of October 18 was Lt. Comdr. Malcolm O. Schetky, industrial officer, U. S. Naval Ordnance Plant, York, Pennsylvania, who discussed how the resources of the oceans may benefit industry and mankind. Color slides accompanied his presentation.

[1]See "Demolition of Ripple Rock," by F. D. Bickel [M.E. May-June 1959].

BRAGG-FAYETTEVILLE

The following officers were elected at the first fall meeting on September 13: Col. Eugene J. Stann, president; Col. James W. Sloat, 1st vice president; James L. Edge, 2nd vice president; Capt. Stuart Wood, Jr., secretary; Capt. Cloyce C. Rogers, treasurer; Lt. Jack J. King, assistant treasurer; and Lt. Col. Henry Howell and Lt. Col. John Redmond, directors.

At the October 18 meeting, Lt. Col. Henry Howell, commanding officer, 307th Engr. Bn. (Abn), spoke on his experiences in Turkey, and George A. Rock, Rock and Co., Plumbing and Heating, spoke on "Pollution of Domestic Water."

BUFFALO

The post held a joint meeting with the Buffalo section of the American Society of Civil Engineers and the Erie County chapter of the New York State Society of Professional Engineers on October 16. Guest speaker was Lt. Col. Leon J. Hamerly, Buffalo District Engineer, whose subject was the "All American Canal."

CAMPBELL

At the luncheon meeting on September 21, Comdr. Edgar Hubert, Jr., spoke on The Society.

The following officers were elected at the October 19 meeting: Col. Sidney Shelley, president; William T. Hodges, secretary; and Lt. (jg) Phillip J. Parisius, treasurer.

CANAL ZONE

A joint meeting was held with the Canal Zone chapter of the American Society of Civil Engineers on September 18. Col. W. P. Leber, Lieutenant Governor of the Canal Zone, gave an illustrated lecture on current and recent Corps of Engineers projects around the world.

The October 9 meeting was held at the Flamenco Island Hawk Missile Battery Site, where members were informed of the mission and capabilities

CANAVERAL—New officers for 1961-1962, l to r: Donald E. Heintzelman, 1st vice president; Donald E. Eppert, president; Brig. Gen. O. L. Grover, temporary program chairman; L. A. W. Fort, treasurer; Jack Newgent, secretary; and Edward Bramlitt, 2nd vice president.

DALLAS—Post officers: Seated, l to r: Randolph Smith, 1st vice president; Col. A. Kroeber, president; and J. R. Penix, 2nd vice president. Standing: Col. F. McGinnis, Jr., director; Col. R. L. Powell; J. White, Jr., assistant secretary; and S. S. Elkins, secretary-treasurer.

of the battery and taken on a tour of the installation and equipment. A social hour and dinner were held afterwards at the Fort Amador Officers' Club.

The following new officers were elected: Col. John E. Unverferth, president; Col. Walter P. Leber, 1st vice president; Lt. Comdr. Warren H. Smith, secretary; Frank South, treasurer; Earl V. Almquist, assistant treasurer; and Maj. Gen. W. A. Carter, Capt. Roscoe E. Van Liew, and Maj. Felix R. Moss, directors.

CANAVERAL

The following new officers were installed at the September 28 meeting: Donald E. Eppert, president; Donald E. Heintzelman, 1st vice president; Edward Bramlitt, 2nd vice president; Jack R. Newgent, secretary; Lt. Arthur W. Fort, treasurer; and Brenton Kirk, Lt. Col. Paul Kurek, and Comdr. Ogden J. Martyn, directors.

At the meeting of October 19, J. T. O'Malley spoke on "The Atlas Missile and Its Uses," describing various programs for the Atlas missile.

CAPE COD

New officers are: Maj. Robert W. Mix, president; Lt. Comdr. Isaac Hills III, vice president; and Lt. Raymond H. Bardwell, secretary-treasurer.

A shore erosion report was presented at the June 27 meeting, in which it was stated that a committee had been formed for the improvement of shore conditions, and that the Corps of Engineers had made an engineering study on the north shore of the Cape, and is now studying the south shore. Harold Sanford, resident engineer, then presented a film on the Bomarc B Missile Construction.

Films on the DEW Line construction were shown at the September 26 meeting.

CENTRAL TEXAS

Lt. Robert W. Byron, Jr., has been elected assistant secretary-treasurer.

"Ladies Night" was held on October 2 at the Killeen Base Officers Open Mess, where pupils of Killeen High School presented an interesting program of music.

CHARLESTON

An outdoor cook-out to mark the beginning of the new season and to attract new members was held on September 28 at Seaside Farms.

The post visited the Charleston plant of the West Virginia Pulp and Paper Company on October 26. Following a tour of the plant, a social hour and dinner were held, at which a representative of the Savannah Post outlined the program for the Southeastern Regional Conference.

CINCINNATI

On October 21 members and guests went on a field trip to inspect construction on the $52,000,000 Markland Dam project on the Ohio River. The dam, constructed by the Jones Tomkins Contractors under the supervision of the Louisville Engineer District, will consist of 12 gates, each 42 feet high by 100 feet long, between 15-foot-wide piers.

On November 3 and 4 the post made its annual visit to the Bluefield Hunting Club and Game Preserve.

CLEVELAND

A dinner meeting was held on September 13 at the Cleveland Engineering and Scientific Center. Following a moving picture on icebreaking operations of the U. S. Coast Guard in the inland waters of the Great Lakes and in the Arctic and Antarctic regions, Capt. H. R. Chaffee of the Coast Guard answered questions.

Members gathered at the Cleveland Engineering and Scientific Center for a dinner and social hour on October 11. The program consisted of two interesting films dealing with the laying of two 20-inch-diameter oil pipe-

CHICAGO—Speaker's table at the November 9 meeting at the Museum of Science and Industry. L to r: Brig. Gen. Lawrence W. Whiting and Maj. Lenox R. Lohr, directors; Lt. Gen. Walter K. Wilson, Jr., guest speaker; and Col. J. B. W. Corey, president.

lines across Mackinaw Straits and the building of Glen Canyon Dam on the Colorado River. Lt. Comdr. William R. Langrill gave an interesting talk on his experiences with a Seabee unit.

COASTAL BEND

At the September 6 meeting, marking the beginning of the post's third year, John A. Woodward and Dr. Frank B. Howard of the Toastmasters Club demonstrated the proper and improper techniques of introducing a speaker.

Herbert W. Whitney, city manager of Corpus Christi, Texas, guest speaker at the October 4 meeting, described the function of the civil defense organization during Hurricane "Carla" and indicated the improvements that can be made from the experience gained during the hurricane.

The development of a "Common Market of Europe" was the subject of a talk by Theodore Hartley at the November 1 meeting. Mr. Hartley is an engineer and administrator with a wide variety of experience in government and private industry. He had just returned from conducting a tour in Europe, and offered his audience the benefits of his close observation of the Common Market at first hand.

COLUMBUS

The post held a luncheon meeting on September 28. Roderick McAlpine of Bell Telephone Laboratories spoke on SCAN, the Switched Circuit Automatic Network. Society emblems were awarded to outgoing post officials for outstanding efforts on behalf of the post.

Michael Tikson, consultant and head of the Digital Computer Center, Battelle Memorial Institute, described "The Use of Computers in Engineering Design" at the October 26 meeting.

The post has voted to contribute $50 to the Franklin County United Appeal Fund.

DALLAS

Col. Adolf Kroeber presented a sustaining membership certificate to Comdr. D. W. Wildfong of customer service at Temco Electronics and Missiles Company of Dallas, at the September 18 meeting at the Hotel Adolphus. Dr. Howard Henry, dean of the Engineering School at Southern Methodist University, spoke on graduate education and research there.

At the meeting of October 9, Gordon Sibeck, of George H. Dahl, architect-engineers, spoke on "Structural Innovations in Modern Architecture."

DENVER

Ted Stell of the public relations department of The Martin Company, Denver, discussed "The Communist Plan for World Domination" at the September 16 meeting. He emphasized individual fulfillment of civic duties at the local level, to strengthen our traditional institutions and national values, as the principal way the ordinary citizen may effectively make a contribution to our defense.

COASTAL BEND—Officers for 1961-1962, l to r: Capt. R. E. Slattery, H. L. Sisson, and W. W. McClendon, directors; Seldon Broughton, secretary; Irving M. Dietz, Jr., president; Comdr. A. W. Terry, vice president; Paul Harris, treasurer; and David Roberts, assistant secretary-treasurer.

Ernest P. Mills, director, Industrial Training, Public Service Company of Colorado, spoke on engineering education at the October 21 meeting. The talk was the second of a series in the post's "Project P. E." (Professional Environment) program. The program consists of one lecture each month in the fields of national military strategy, law, economics, safety, wage and salary administration, communication, or human relations. The lectures are non-technical in nature and of interest to all engineers regardless of specialty or experience.

DETROIT

Dr. Armand DiGiulio spoke on "Metals as They Pertain to the Space Age" at the October 10 luncheon meeting. He described how the metallurgist and industry have solved the problem of maintaining the stability of metals under extremely high reentry temperatures.

EL PASO

The Albuquerque and Holloman Posts joined the El Paso Post at its meeting on September 8. The guest speaker was Maj. Gen. Robert J. Fleming, whose topic was "The Carbon-copy Curtain."

Students from Texas Western College were guests at the October 9 meeting at the Ramada Inn. Nicholas Perez, Jr., county engineer, spoke on his experiences in civilian and army engineering.

FORT BELVOIR

"This Revolutionary Age" was the subject discussed by Edwin M. Wright, of the Department of State, at the October 11 meeting. His talk pointed out that all modern revolutions have been brought about by technological improvements or the introduction of new "tools" into a society. Maj. Gen. S. R. Hanmer, Engineer Center and Fort Belvoir commander, was among those present.

Engineering features of the Chesapeake Bay Bridge Tunnel were described by P. Z. Michner, project manager, at the meeting of November 8.

FORT LEONARD WOOD

About 185 post members and their guests attended the annual picnic held on September 16 at the Fort Leonard Wood officers picnic area. The following new officers have been elected: Capt. Clifford N. Hanson, secretary, and Rea Reid, treasurer.

At the October 10 meeting, Maj. Gen. Howard Ker, commanding general, Fort Leonard Wood, Missouri, was awarded a Certificate of Appreciation for his services as Middle European Representative of The Society in 1959 and 1960. Dean Curtis Wilson of the Missouri School of Mines and Metallurgy spoke briefly on "The Strength of a Nation."

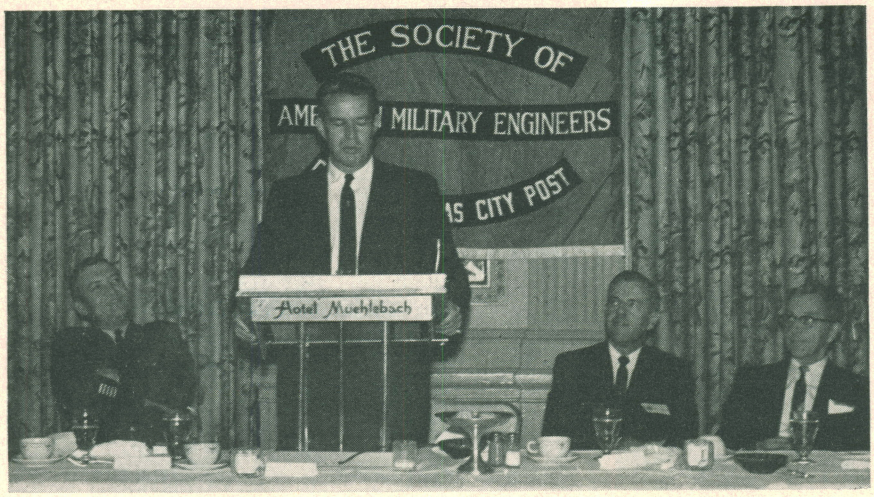
FORT WORTH

New officers were elected at the October 4 meeting: Olen W. Yandell, president; Samuel P. Martin, 1st vice president; Morris S. Denman, secretary; and William B. Edgar, Jr., treasurer. A briefing, illustrated with slides, on "Counterforce for the 1960's" was presented.

On November 8 the post met at the Fort Worth factory of Lennox Industries, Inc. Donald W. Belknap, assistant sales manager, summarized the plant operations and conducted a tour of the facilities.

FRANKFURT

Dr. Max Barnick, director of Battelle Institute, spoke on the develop-



GREATER KANSAS CITY—Congressman Richard Bolling at the speaker's stand. Seated, l to r: Col. A. P. Rollins, Jr., president; Col. Ralph O. Heatley; and Col. Ira D. S. Kelly.

ment of German industry since World War II at the October 16 meeting, and speculated on future industrial trends.

GREATER KANSAS CITY

On September 27, following a social hour and dinner, E. H. Swick, director, Region 5, Bureau of Public Roads, spoke on "The Future of Personal Transportation." He pointed out the problems associated with the continually increasing "people-miles" of travel, and emphasized the increase in road capacity that may be achieved by planned control of access to roads and by the development of the Interstate Highway System.

Congressman Richard Bolling, 5th Congressional District, Missouri, spoke on "Congress and the National Defense" at the October 25 meeting.

GUAM

On June 13, the Guam Legislature introduced a resolution commending the post for its scholarship program. The post initiated the program in 1956 by raising funds for tuition, books, board and room, miscellaneous funds, and transportation to the University of the Philippines at Manila. In 1958, three students from Guam High School were selected to attend the Territorial College of Guam for a year to complete an engineering preparatory course before entering the University. All expenses were paid by the post. Of these three students, John Onedera, a resident of Ipac, Tumon, and a graduate of Mong-Mong High School, was selected as the most outstanding student. Some $6,000 has been contributed to date. Considering there are but 90 members in the post, this is a very commendable accomplishment.

The scholarship now provides for a four-year course in civil, mechanical, or electrical engineering, leading to a degree of Bachelor of Science.

The fund-raising campaign of 1959-1960 not only provided funds for Onedera's final year at the University, but it also permitted the early selection of a second student to attend the University of the Philippines.

In the Spring of 1961, five candidates in the first and second year at the College of Guam were interviewed by the Scholarship Committee.[1] Each student was required to show outstanding proficiency in mathematics, chemistry, and English. In addition, aptitude, health, attitude, sincerity of interest in an engineering career, as well as character, were considered. Final selection of the candidates was made after a review of the scholastic records, interviews with professors and local sponsors, and personal contact with the students.

Thus the post contributes to the technical and future industrial development of the Marianas Islands. In addition, the scholarships will serve as an incentive to local young men in the engineering field.

HAMPTON ROADS

The post held its annual Ladies Night meeting on September 22 at the Norfolk Yacht and Country Club. Vice Adm. C. L. G. Evans, Deputy Supreme Allied Commander Atlantic, spoke on the mission and responsibilities of the Supreme Allied Command and discussed the international situation and the Allied preparedness efforts.

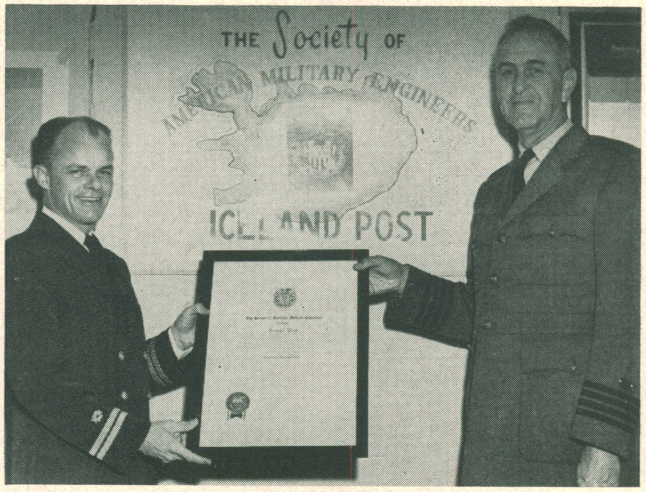
HEIDELBERG

Maj. Gen. W. H. Nutter, USAREUR Chief of Staff, was guest speaker at the meeting of September 22. Maj. Gen. T. H. F. Foulkes, OBE, Engineer-in-Chief of the British Army, attended.

Over 200 members and guests met at the Casino Annex on October 13, when the post's principal speaker and guest was Lt. Gen. Walter K. Wilson, Jr., U. S. Army Chief of Engineers. Among those attending were Maj. Gen. W. C. Baker, Jr., Brig. Gen. E. I. Davis, and Brig. Gen. R. B. Warren, who accompanied General Wilson on his European tour and inspection. General Wilson spoke on recent developments within the Corps of Engineers. His talk was accompanied by many interesting slides on current re-

[1]Capt. P. W. Roberts and Comdr. Robert L. Hall, CEC, USN; George Hartung and T. C. Biernacki of the Public Works Center; Chet Eyer, Guam Public Utility Agency; and S. M. Forkner, a contractor.

HEIDELBERG—Brig. Gen. E. I. Davis, Lt. Gen. Walter K. Wilson, Jr., and Brig. Gen. R. B. Warren, at the October 13 meeting.



ICELAND—Lt. W. J. McCorkle (left) hands over the Charter of Incorporation of the post to newly elected president, Capt. L. R. Brown.

INDIANA—Pictured at the post annual meeting, l to r: Maj. William Prescott, Francis H. Beach, Col. Arthur W. Herrington, John Corona, and Donald W. Porter, seated. Standing are Robert L. Malcom, Lt. Col. Ralph S. Manning, Earl C. Smith, Lt. Col. Howard H. Bates, Pablo Rivera Mojica, Joseph C. Rah, Lt. Col. Robert E. Hisle, Lt. Col. Lowell J. Mueller, Capt. Robert F. Tindall, Jr., and Herman C. W. Schnepf.

search and prototype equipment for accomplishing engineer tasks.

HOLLOMAN

Lt. Col. William M. McCain, deputy for civil engineering, AFMDC, spoke on architecture in various countries at the September 11 meeting. Slides were shown of structures in Italy, Germany, Austria, Switzerland, Japan, and Hawaii.

HUNTSVILLE

The "Legal Dilemma of the Space Age" was the subject discussed by Andrew Bratcher of the George C. Marshall Space Flight Center at the September 28 meeting. The sovereignty of riparian rights to waterfront and space areas and to the space between the earth and the moon were among the questions considered.

Walter Wiesman, Army Ordnance Missile Command, Redstone Arsenal, Alabama, was guest speaker at the October 26 meeting.

ICELAND

The following new officers were elected at the meeting of August 25: Capt. LaMonte R. Brown, president; Gudmunder Einarsson, vice president; Juergen Pleines, treasurer; and Lt. Comdr. John A. Arn, J. Cates, Harold Heeszel, James Young III, Einar Eyfells, and Daniel Einarsson, directors. A dinner and dance followed the business meeting.

Members attended a dinner meeting on September 29, followed by a showing of two films, "Construction at Sea" and "The Mackinac Bridge Diary." A dance in the main ballroom of the officers club followed.

The film, "Rescue at Látrabjarg," was shown at the dinner meeting on October 27.

INDIANA

At the annual meeting on September 15 at the Indiana War Memorial, the following officers were installed: John Corona, president; Francis H. Beach, vice president; Maj. William Prescott, secretary; Donald W. Porter, treasurer; Alexander G. Beckmann, assistant secretary-treasurer; and Col. Halbert E. Fillinger, Lt. Harry E. Hunter, and Lt. Col. Ralph S. Manning, directors. Col. Arthur W. Herrington was made lifetime director. John Corona accepted the post flag Colonel Herrington had donated to the post.

Lt. Col. Lowell J. Moeller discussed the recent organization of the Indianapolis Scientific and Engineering Foundation. The post unanimously voted to join the foundation.

Lt. Col. Howard H. Bates then spoke on Indiana's response to Lincoln's call for 75,000 volunteers for service in the Civil War.

At the October 10 meeting, Comdr. M. Cliff Boyer, hydraulic engineer with the Indiana Flood Control and Water Resources Commission, spoke on "Civil Defense Co-ordination in a Natural Disaster."

KAISERSLAUTERN

The following new officers were elected at the October 24 meeting: Col. Frank A. Camm, president; Lt. Col. Felix R. Garrett, vice president; Capt. Franklin O. Mikle, secretary; and Capt. Richard T. Robinson, treasurer.

KENTUCKIANA

A film entitled "City under the Ice" was shown at the September 13 meeting. Capt. James C. Crawford, executive officer, 538th Engineer Battalion (Const), spoke on the Inter American Geodetic Survey at the October 4 meeting.

KITTYHAWK

The following new officers were elected at the October 25 meeting: Maj. Gen. Joseph E. Gill, president; Maj. Herbert V. Larson, vice president; Capt. W. T. Johnson, Jr., treasurer; and Capt. James M. Dellaripa, assistant secretary-treasurer.

Wilson A. Maxim of the Directorate of Advanced Systems Planning was guest speaker. He discussed the advanced planning of weapons as opposed to the experimental and operational development phases of Air Force weapon systems acquisition.

KOREA

Brig. Gen. W. W. Lapsley, commanding officer, 7th Logistical Command, spoke on "Flood Control and Navigation of the Ohio River" at the September 11 meeting.

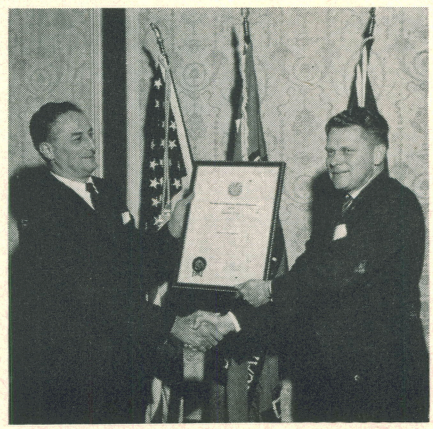
"Mining in South Korea" was the subject of a talk given by George Hikes, chief, Mining Division, USOM, Korea, at the October 16 meeting. Colored slides and maps of mining areas in South Korea supplemented his presentation.

Col. Myron E. Page reported that two students, Kim Jung Jae and Chung Chon In, had been selected to receive scholarships to the College of Engineering, National University, Seoul. The members of the post accepted the committee's recommendations.

LONDON

The annual Ladies Night was celebrated at the September 12 meeting. The affair was a great success, due in large measure to the guest speaker, Jeanne Heal, radio and television actress.

New officers were elected as follows at the October 3 meeting: Col. James W. Kimsey, president; James A. Skinner, vice president; Olivier A. Goulet, treasurer; and Cleon M. Arnold, Col. James A. Barnett, Paul Brandt, James R. Coen, William E. Duncan, Maj. Jacob F. Fullilove, Jack Gettings, Ray E. Jones, and Lt. Col. Edward R. Ross, directors. "Pipeline into Persia," an award-winning documentary film that portrays the construction of an oil pipeline in the Middle East, was shown by Hector D. Walker of John Brown, Ltd., Constructors, the company that laid the pipeline.



LONDON—Outgoing president S. C. Lipman handing the post charter to Col. J. W. Kimsey (right).

LOS ANGELES—L to r: Roy G. Johnston, president, Structural Engineers Association of Southern California (Los Angeles); Colonel Frye; Capt. William T. Wright, post president; and Samuel B. Nelson, president, American Society of Civil Engineers (Los Angeles).

LOS ANGELES

The post met jointly with the Structural Engineers Association of Southern California and the American Society of Civil Engineers for a dinner on September 13. Col. Arthur A. Frye, Jr., South Pacific Division Engineer, read the address prepared by Maj. Gen. J. B. Lampert, who was unable to attend. It dealt with the national and world-wide program of the Corps.

Ralph W. King, senior engineer, customer facilities division, AETRON, Aerojet-General, was guest speaker at the October 10 meeting. His discussion included some predictions of the size of future large rocket vehicles, suggestions for location of launching facilities, and some proposed concepts for the launch complex itself.

LOUISIANA

A Ladies Night meeting, with cocktail hour and dinner, was held on October 17, when the following new officers were elected: Lt. Col. Frank H. Walk, president; Capt. Thomas J. Dumont, 1st vice president; Col. Edward B. Jennings, 2nd vice president; Comdr. Tom W. Beck, secretary-treasurer; and Comdr. Rudolph F. Duelfer, Jr., assistant secretary-treasurer.

MANILA

New officers were elected as follows at the October 6 meeting: Comdr. Ferdinand W. Arnold, president; Col. Paulino S. Torio, vice president; Lt. Col. Gregorio M. Yambao, secretary; Maj. Robert P. Binkley, treasurer; Lt. Col. Luis C. Borromeo, assistant secretary-treasurer; and Col. Frederico W. Calma, Maj. Edward Broadhurst, and Maj. Charles T. Mulvaney, directors. An award was presented to Capt. Amado Santiago, Jr., the Allied honor graduate of the 2d Engineer Officer Career Class, 1961, held at the Engineer School, Fort Belvoir.

MEMPHIS

Guest speaker at the September 25 meeting was Capt. J. J. Munson, commanding officer, Memphis Naval Air Station. Captain Munson had just returned from two years of duty in Moscow as naval attaché. His subject was "The Russian Bill of Rights."

Karl W. Bissly, director, Memphis Bureau, Federal Bureau of Investigation, spoke on "Bureau Activities in Memphis and the Mid-South" at the October 23 meeting.

MINOT

Ladies Night dinner was held on June 21. Mr. Bacon, local prestidigitator, performed feats of magic to entertain the guests. Dancing followed, and it is reported that "the meeting dispersed only when the physical strain of advancing age overtook the anxiety of youth."

On July 19 post president Lt. Col. Thomas A. Barry spoke on the role of the Corps of Engineers in peace and war. A film illustrating Corps accomplishments and growth was shown.

At the invitation of Milo W. Hoisveen, president of the Association of Western States Engineers, post members journeyed to Bismarck, North Dakota, for the meeting of August 16. Guest speaker was Lt. Gen. Walter K. Wilson, Chief of Engineers, who explained the benefits of the programs formulated and supported by organizations such as the Association.

Wilmar Urban, civil defense director, Northwest Area, North Dakota, was guest speaker at the meeting of September 18.

New officers were elected at the meeting of October 18: Capt. Herbert R. Foster, president; Maj. James O. Kyser, 1st vice president; S/Sgt. David Conroy, 2nd vice president; Edward N. Ove, Jr., treasurer; and Maurice G. Isaacson, assistant secretary-treasurer.

Guest speaker was George L. Tyson, assistant chief engineer, Pre-Construction Division, North Dakota Highway Department, who discussed the North Dakota part of the new system of Interstate and Defense Highways.

MOBILE

The September 21 meeting was an informal reception to honor the new District Engineer, Col. D. A. Raymond. The program included presentation of a film showing the experimental rocket aircraft "X-15" now under development by the National Aeronautics and Space Administration.

Colonel Raymond spoke on military construction on Okinawa and in other Far East locations at the October 12 meeting.

MOUNT TACOMA

At the September 11 meeting, Lt. Comdr. Frankland Smith, City of Tacoma Power and Light Company, spoke on the progress of the Mayfield Dam on the Cowlitz River, showing slides of highlights of the construction phases. The slides included the fish trolley lift, which transports 98 percent of the salmon to the top of the dam.

At the meeting of October 2, Roland A. Glaze of Rilco Laminated Products spoke on the engineering aspects of the manufacturing process of laminated beams and trusses. His talk was accompanied by a film showing how laminated products are used.

The following new officers were elected at the November 6 meeting: Col. Jack K. Gamble, president; Wesley E. Taft, 1st vice president; Maj. Richard C. Bauml, 2nd vice president; and Herrick K. Allen, secretary-treasurer. Charles Abbott, of Alaska, spoke on heavy construction problems during the building of Radar DEW Line stations and the WHITE ALICE-Microwave communication system. He showed 35mm color slides to illustrate the construction problems of concrete footing, foundations, and the erection of steel towers.

NAPLES

The luncheon meeting on September 28 was attended by members and guests from the French Navy, the Greek Air Force and Turkish Air Force, and Italian and American military and civilian engineers. B. L. Beisecker of Booz, Allen and Hamilton, International, spoke on the work his firm has been doing in the management organization field. Engineer Mencarelli, director of Italsider Steel Corporation, was a guest of the post.

OAHU

Frederick H. Kohloss of Frederick Kohloss & Associates was guest speaker at the September 12 meeting. He spoke on new developments in thermal engineering.

The October 10 meeting consisted of a tour of the Red Hill underground fuel facility.

In 1961, the post established a scholarship program for ROTC students at the University of Hawaii. The first two scholarships, for the semester beginning September 27 at the University of Hawaii School of Engineering, were awarded to one Army and one Air Force ROTC student at the beginning of their Advanced ROTC Program. The grant will total $400 per student, $100 for each of the four semesters.

The scholarships were established to develop competent engineers interested in military engineering as a profession, as well as to support the ROTC contract program at the University of Hawaii.

The dean of the engineering school at the University of Hawaii and the Army and Air Force Military Science instructors (the University does not have a Navy ROTC Program) have

co-operated fully with the Post Scholarship Committee.

To be eligible, students must demonstrate superior performance in the School of Engineering and in the Advanced ROTC Program. Merit, rather than need, determines who will receive the award.

Stanley Kenji Kawaguchi, 20, received the first Army ROTC scholarship, and G. M. Hayashi, 19, of the Island of Hawaii, received the first Air Force ROTC scholarship. At the October 10 meeting they gave short talks expressing their appreciation for the awards and outlining their plans for careers in military engineering.

Providing each student continues to qualify, the post scholarship will be renewed each semester until the student has completed his senior year. Should a student fail to qualify for the award during any semester, it will be given to another student. Two similar awards will go to two more ROTC students who will begin their advanced ROTC training next year.

OKLAHOMA CITY

New officers were elected as follows at the September 20 meeting: Raymond L. West, president; John F. Benham, 1st vice president; Capt. William T. Hemmer, 2nd vice president; Bill L. McCurdy, secretary; Herbert Lang, treasurer; D. L. Rosebrook, assistant treasurer; and Capt. John H. Frederickson, Jr., Francis C. Dickinson, Francis D. Lyons, and Edward J. Glendening, directors.

Three scholarships of $100 each will be presented to the University of Oklahoma Student Post, for an outstanding Army, Navy, and Air Force ROTC student.

OLMSTED

On October 3, John Leak, senior structural engineer of the Civil Aeronautics Board Bureau of Safety, gave a well-illustrated account of several typical airline accident investigations.

OMAHA

At the September 12 meeting, Donald K. Knight of the Omaha Engineering District, Corps of Engineers, spoke on "The Drilling of the Deep Disposal Well for the Rocky Mountain Arsenal." Mr. Knight and J. O. Ackerman, program chairman, answered many questions on this unusual project.

OKINAWA

The guest speaker at the November 6 meeting, Mr. Ades, discussed the "Gas Turbine Powered Power Train."

ORLANDO

Members and their wives met for dinner on September 12 at the home of Mr. and Mrs. Paul A. Dolezar, where conversation ranged from horse and buggy days to travel in space.

At the October 17 meeting, William Fortune of The Martin Company spoke on "Value Analysis."

ORLEANS

At the September 5 meeting, Lt. Col. Joseph I. Gurfein, engineer, Orleans Area Command, spoke on "The Origins of Mathematics."

Dr. Robert S. Wiseman, chief, Warfare Vision Branch, Engineer Research and Development Laboratories, Fort Belvoir, Virginia, spoke on "Vision in the Night" at the October 9 meeting.

OXNARD-VENTURA

On September 8, the post met jointly with the ASCE and the Ventura Engineers Club for a tour of the Conejo Valley Sanitary Company plant and a barbecue.

John T. Tucker, director, Equipment Division, NCEL, discussed the "Conquest of Inner Space" at the October 10 meeting.

PARIS

A dinner meeting was held at "Les Noces de Jeannette" on September 28. William Feidt of the NATO International Staff led a discussion on arctic construction, using the Corps of Engineers film, "Men, Ice, and Steel," as part of his presentation.

At the November 2 dinner meeting at the Restaurant Camille Renault, Capt. Harry H. Bagley led a discussion on "The Netherlands Delta Plan." The discussion and an accompanying film, "Hold Back the Sea," loaned by the Shell Corporation, graphically described the 800-year battle of the Netherlands against the sea, and the attempts to reclaim once-fertile land. The discussion concluded with a consideration of the Delta Plan, which was approved in 1955 at an estimated cost of $660,000,000, and will take 25 years to complete.

PHILADELPHIA—Col. C. W. Chapman, Jr. (center), with Col. T. H. Setliffe, president, and Capt. R. B. Atkins, vice president.

PHILADELPHIA

"The Navy in Space" was the subject of an illustrated address by Capt. R. H. Bosee, director of the Air Crew Laboratory, Navy Air Material Center, at the meeting on September 27 at the Center. Captain Bosee told of the part the Navy is playing in the launching of rockets and in the development of missile and space equipment. Members and guests witnessed a demonstration of an ejection seat on a 150-foot tower. During the social hour, movies were shown covering the history of the Naval Air Material Center.

The Army Corps of Engineers Military Research and Development Program was the subject of an illustrated talk by Col. Curtis W. Chapman, Jr., Office, Chief of Engineers.

The officers from Pennsylvania Military College and Drexel Institute of Technology Student Posts, together with 16 members of the Drexel Student Post and their faculty advisor, Maj. Robert C. Nelson, attended.

OAHU—Post scholarship winners were introduced to members at the October 10 meeting. L to r: Col. W. G. House, post director; Col. V. L. Boylan, professor of military science, University of Hawaii; Stanley Kenji Kawaguchi, Army ROTC scholarship winner; Gilbert M. Hayashi, Air Force ROTC scholarship winner; Donald S. Austin, post president; and Col. I. M. Parsons, professor of Air Science at the University of Hawaii.

PISCATAQUA—Comdr. Charles Rust (second from right) shows a model of the Polaris submarine to George Fiske, while Lt. Col. R. C. Stubblefield, left, and Capt. J. E. Rehler, temporary president, inspect a model of the Polaris missile.

SACRAMENTO—Maj. A. A. Becker shows the Sacramento State College Engineers Club the deep-water ship channel. L to r: Major Becker; Col. Herbert N. Turner, District Engineer; and Professors N. C. Castellan, Kenneth Kerri, and C. H. Drown, faculty advisors.

PISCATAQUA

Interim officers were selected at a reorganization meeting on September 18, as follows: Capt. Joseph E. Rehler, president: Lt. Col. Wyman Boynton, vice president; Philip T. Boothby, secretary; and Harlan Reynolds, treasurer.

Comdr. Charles Rust, Polaris Task Group officer at Portsmouth Naval Shipyard, was guest speaker at the October 5 meeting.

POLARIS

The August 13 meeting consisted of a picnic and field trip to the Chatanika Power Plant north of Fairbanks, Alaska. Arnold Hanson, chief engineer of the Reed & Martin Corporation, accompanied the group through the plant.

James D. Crawford, vice president and general manager, U. S. Smelting, Refining and Mining Company, spoke on "Engineering Problems Associated with Gold Mining in Alaska" at the October 16 meeting.

PORTLAND

A luncheon meeting was held on September 13. Col. Samuel M. Lipton gave an informative talk on the Corps of Engineers construction program in the Northwest. Color slides showing some of the characteristics of Corps construction completed his presentation.

Lt. Col. Chester O. Moorhead has been appointed as director to replace Col. Eric Dougan, who has been transferred.

At the October 11 meeting, Jack Capell, staff meteorologist for television station KGW-TV, spoke on the Tiros and Nimbus space satellites.

RIVERDALE

Col. F. E. Murphy, assistant to the North Dakota Civil Defense Director and the area director of the North Dakota Mobile Units, spoke on civil defense at the September 28 meeting.

ROCK ISLAND

The following new officers have been elected: George A. Lewthwaite, president; Col. Richard L. Hennessy, vice president; Richard F. Wherry, re-elected secretary; Frank J. Mollner, Jr., treasurer; and J. Richard Smith, assistant treasurer.

Congressman Fred Schwengel, a member of the Public Works Committee of the U. S. House of Representatives, spoke on "Public Works in the 60's" at the October 12 meeting. He reaffirmed his support for a higher clearance for Interstate Highway 80 bridge at Le Claire, Iowa, and called for prompt completion of Interstate 80 across Iowa.

SACRAMENTO

At the meeting of September 28, Henry B. Berndt and H. L. Fougerousse of Executone, Inc., presented some of the latest developments in electronic communication, sound, and signaling systems.

On October 21, the post was host to 35 student members of the Sacramento State College Engineers Club. The day's activities consisted of a luncheon at the Sacramento State College Faculty Dining Room, followed by a tour of the Sacramento Deep-water Ship Channel now being constructed by the Sacramento Engineer District. The tour of the ship channel was conducted by Maj. Arthur A. Becker of the Sacramento Engineer District.

Col. Herbert N. Turner, Sacramento District Engineer, welcomed the students and faculty for the occasion, and outlined the purpose and aims of The Society. Lt. Col. C. C. Baldwin discussed the establishment of a student post at the college.

SAIGON

The August 11 meeting consisted of a farewell dinner for Brig. Gen. Alden K. Sibley, first president of the post, and Col. Raymond A. Seifert, first vice president. Both expressed their regret at leaving and their best wishes for the continued success of the post. The evening ended with dancing for members and guests.

Members enjoyed a talk and film presented by Leonard C. Reynolds, railroad engineer with USOM, on the railroad system of Vietnam at the September 21 meeting.

Stanton C. Funk, project manager of Capitol Engineering Corporation in Saigon, gave a talk describing Vietnam's highway program at the October 19 meeting.

The post has embarked on a program of assistance to the new National Technical Center of Vietnam, and plans to establish relations with the Vietnamese Engineers Association.

SAINT LOUIS

The fall season was initiated with a barbecue held at Tilles Park on September 30, where members and their families enjoyed a pleasant evening.

SAN FRANCISCO

The fourth annual family day picnic was held on September 16 at the Charles Krug Winery, St. Helena, California.

Robert Dalton, Jr., and Donald Bentley have been elected directors.

Lt. Comdr. Frank G. Adkins, resident supervisor of ship building at Food Machinery Corporation, illustrated his talk at the October 12 meeting with models and films.

SAVANNAH

At the September 19 meeting, Dr. Julian K. Quattlebaum, Sr., prominent Savannah surgeon and an outstanding authority on auto racing, presented a detailed history of the Vanderbilt Cup and Grand Prize races which brought international attention to Savannah for three years shortly after the turn of the century. His talk was illustrated by many photographs of the races.

SCOTT FIELD

Several members and guests participated in an informal field trip to the River King Mine of the Peabody Coal Company on August 22.

New officers were elected on September 19: Lt. Col. Gus J. Pappas, president; Maj. Romeo H. Freer, vice president; James A. Cobb, secretary; Leonard R. Pranger, treasurer; Max M. James, assistant secretary-treasurer; and Col. James S. Barko, Stephen J. Bernstein, and Capt. William McCallum III, directors. They were installed at a dinner-dance on November 3.

SEATTLE

W. A. Bugge, State of Washington Highway Director, guest speaker at the September 18 meeting, discussed the Federal freeway and limited-access system in Washington. This 17-mile section will cost more than $141,000,000. W. E. McKibben, Highway Department District Engineer in Seattle, also gave a short illustrated lecture on the model of the Seattle section.

On October 14, members journeyed by ferry to Bremerton, Washington, to inspect the world's largest dry dock now under construction at the Puget Sound Naval Shipyard. The mammoth structure, 1,180 feet long, 61 feet deep, and 180 feet wide, will be the only dry dock in the United States able to accommodate supersized carriers.

After lunch members visited the battleship *Missouri* and inspected the huge floating caisson which will serve as the closure gate for the dry dock.

SUBIC BAY

New officers were elected at the September 21 meeting: Lt. Comdr. Thomas J. McGhee, president; Comdr. Ralph B. Grahl, vice president; Antonio Y. Balde II, secretary; Warren A. Sullivan, treasurer; Adrian S. dela Paz, assistant secretary-treasurer; and Capt. Thomas J. Doyle, Howard Q. Mar, and Nester N. Niguidula, directors.

Guest speaker was Carlos Fernandez, president of the Philippine Association of Construction Manufacturers, who traced the history of research and development in the use of indigenous raw materials for construction purposes.

SEATTLE—Inspecting dry dock at the Puget Sound Naval Shipyard. L to r: K. C. Helms, past president; Lt. Col. D. M. Pelton of the Seattle Army Engineer District; and Capt. E. I. Mosher, of the Northwest and Alaskan Division, Bureau of Yards and Docks.

Capt. Eugene H. Maher, commanding officer, U. S. Naval Station, Subic Bay, spoke on DEEPFREEZE operations in the Antarctic at the meeting of October 19, using slides to illustrate his talk. Guests present included Capt. J. B. Elliot, Jr., skipper of the USS *Klondike,* and Benjamin Paradeza, recipient of the post scholarship.

The post now sponsors two scholarships in the Philippines, one at the Naval Reservation College and one at the Mapua Institute of Technology in Manila. Each scholarship has a value of $50 per semester and covers the full tuition.

The first scholarship was awarded in June 1961, the month the academic year begins in the Philippines, to a 17-year-old Filipino to attend the Naval Reservation College. The second scholarship was awarded in September 1961 to a student at Mapua Institute. It will cover the final three years of the five-year engineering course.

Students attending the Naval Reservation College come from a 50-mile radius of the Subic Bay Naval Base. The student receiving the scholarship at Mapua Institute must be a resident of the Island of Luzon.

Rather than developing a special fund-raising campaign, the post obtains its scholarship funds through a surcharge added to the cost of lunches at the regular monthly meetings. The price of $1.50 for U. S. members and 58 cents for Philippine members is charged. Each luncheon costs about 50 cents; thus there is an excess for the post treasury. Added to this is a portion of the $3.00 annual post dues. The post hopes to establish a graduate engineering scholarship at the University of the Philippines in the near future.

SYRACUSE

At the meeting of October 17, films of the Air Force Thunderbirds and the Interceptor Gunnery Meet were shown.

TAIWAN

The following officers were elected at the September 14 meeting: Col. Harold E. Beaty, president; Capt. G. D. Akins, secretary-treasurer; and Maj. Quentin D. Quigley, director.

TEHRAN

Two representatives of the Iranian Oil Exploration and Producing Company displayed photographs, diagrams, and maps of the Gach Saran-Kharg Island pipeline at the meeting on July 3.

The July 29 meeting was devoted to a symposium on Water Resources Development in Iran, moderated by A. P. Norwood, civil engineer, Gulf District. Three different phases of water resources development were discussed by the participants: Traditional Iranian

SAN FRANCISCO—Lt. Comdr. Frank G. Adkins distributing pictures of amphibious vehicles to sons of members at October 12 meeting.

Water Systems, by Hassan Ali Mostofi; Modern Water Well Development, by William H. Bierschenk, geohydrologist with the Frank E. Basil Company; and Surface Water Impounding and Irrigation Systems, by Ali Gholi Bayani, director of the Dams and Irrigation Division of the Plan Organization. Mr. Bayani's discussion of the present long-range plan for conservation of surface water supplies and the economics of ground water conservation stimulated a lively and interesting participation by the audience, in which the advantages and disadvantages of the various water resources development methods now employed were discussed.

The Honorable Julius C. Holmes, American Ambassador to Iran, was guest speaker at the September 18 meeting. He complimented the Gulf District and the post on their response to community needs in sponsoring such institutions as the Iran American Society and assisting with the contract details and supervision of improvements to the Dreyfus Clinic.

At the October 6 meeting, Maj. Gen. J. B. Lampert, deputy chief of engineers for construction, spoke on the mission of the Corps of Engineers.

TUCSON

Col. Strother B. Hardwick, commander, Site Activation Task Force, Davis-Monthan AFB, presented the post charter to Col. Clayton Rust, president, at the September 13 meeting. Don Butterfield, vice president, Idaho-Maryland Corporation, presented the post colors and spoke on his company's role in the ballistic missile program.

John H. Stufflebean, western vice president of the National Society of Professional Engineers and chief engineer of Blanton & Cole, Architect-Engineers, discussed the aims and activities of the society at the October 11 meeting.

TULLAHOMA

At the September 14 meeting, held jointly with the National Society of Professional Engineers, Maj. Gen.

WASHINGTON, D. C.—Alan McCone, special assistant for installations for the Air Force, displays a Society Certificate of Membership presented to him by Rear Adm. Peter Corradi, post president, as Maj. Gen. A. M. Minton, Air Force Director of Civil Engineering, right, looks on.

William L. Rogers spoke on test operations at Cape Canaveral. General Rogers, commander of Arnold Air Force Center, was formerly vice-commander at the Air Force Missile Center at Patrick Air Force Base, which supervises operation of the Atlantic Missile Test Range and the missile launch facilities at Cape Canaveral. His talk was particularly interesting as it showed the end result of the design, construction, research, and development performed at Arnold Center months and even years in advance of actual launchings.

At the meeting of October 13, winners in the post membership contest were announced: E. H. Batts, Jr., with nine new members to his credit; and R. F. House and L. F. Mitchell, each of whom obtained seven new members. The contest resulted in a total of 45 new members and one sustaining member.

TUSCANY

Col. Richard D. Wolfe has been appointed president to fill the unexpired term of Lt. Col. Eri H. Richardson, who has been transferred from the area.

UTAH

Edward J. Heesacker, assistant to the director of the Minuteman program, Thiokol Chemical Corporation, was guest speaker at the September 20 meeting. He discussed the progress of the Thiokol operation in Utah, and the development, composition, and operation of the first-stage engine Thiokol manufactured for the Minuteman missile, with general comments on the over-all Minuteman program. The film "Minuteman—Missile and Mission" accompanied his presentation.

A dinner meeting was held on October 18. Dr. Jessop B. Low of the College of Forest, Range, and Wildlife Management at Utah State University spoke on the problems of maintaining wildlife. An excellent movie entitled "Utah's Deer" concluded the program.

VANDENBERG

Guest speaker for the October 26 meeting was Lt. Col. Richard D. Fuller, resident project engineer for the Army Rocket Guided Missile Agency. Colonel Fuller outlined the Nike-Zeus program at Vandenberg Air Force Base. Brig. Gen. Dwight F. Johns, Western Regional Vice President, also spoke briefly and commented upon the potential of the post.

VICKSBURG

James E. Sanders, fallout shelter survey co-ordinator, Lower Mississippi Valley Army Engineer Division, spoke on "The Shelter Survey Program" at the October 10 meeting.

WALLA WALLA

Guest speaker at the October 9 meeting was Col. James H. Beddow, Walla Walla District Engineer, whose subject was "The Role of the Defense Department in Civil Defense." He gave a brief history of civil defense, and named the five main responsibilities of the Department: a fallout shelter program; a chemical, biological, and radiological warfare defense program; a national warning system; a communications system that will be effective during a national emergency; and emergency assistance in a post-attack period.

WASHINGTON, D. C.

John D. Nicolaides, technical director for astronautics, Bureau of Naval Weapons, was guest speaker at the September 18 meeting. His subject was the relative accomplishments of the Russians and Americans in space. Brig. L. J. Harris, director of Military Survey, British War Office, and Col. R. A. Lindsell, Royal Engineers, British Army Staff, were guests at the meeting.

Don C. Lindsten, chief of the research section, Sanitary Sciences Branch, Army Engineer Research and Development Laboratories, spoke on present knowledge of the atmospheres of the nearby planets, at the meeting on October 16. Mr. Lindsten described how this information was developed, and discussed the possibility of life under the conditions envisioned. The members of the Civil Engineer Corps Conference attended the meeting.

WESTERN NEW ENGLAND

New officers were elected at the meeting of September 20: Col. Archie S. Mayes, vice president; Carmine P. Asprinio, secretary; Robert T. Bogan, treasurer; Lt. Col. Harold B. Smith, secretary-treasurer; and Lt. Col. John G. McCann and Chester H. Cooper, directors.

WIESBADEN

At the September 19 meeting, John Quinn of the Republic Aviation Corporation spoke on the development of the F105 weapon system and showed a film outlining its capabilities.

Mr. Holtzclaw, measurement engineer, Hq. European GEEIA Region, gave an interesting talk on "Radiation Hazards from Ground Electronics Equipment" on October 12.

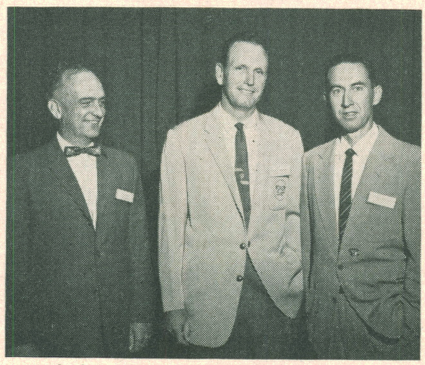
YOKOSUKA-YOKOHAMA

"Fancy Thoughts and Theories," dealing with the responsibilities of Americans stationed in foreign countries, was the title of a talk given by Earnest Hoberecht, vice president, Asia Division, United Press International, at the September 18 meeting.

The featured speaker at the meeting of October 16 was Father Robert J. Ballon, S.J., director of finance, Sophia University, in Tokyo. His subject was "Postwar Japanese Labor," dealing with the labor union movement since World War II. He pointed out that in 1945, some 45 percent of labor in Japan was organized, and in 1961 only 35 percent was organized.

YUMA

On September 18 the post visited the Yucca Power Plant. Cleo Walker, superintendent, gave a brief talk and conducted a tour of the plant.



YOKOSUKA-YOKOHAMA—Officers and directors of the post. In the picture at the left are: Comdr. D. C. More, secretary-treasurer; Capt. F. A. F. Cooke, president; E. A. Shay, vice president; and Ens. C. G. Sahlman, assistant secretary-treasurer. Shown at right are: Comdr. C. F. Mobley, Capt. C. J. Merdinger, and Lt. Comdr. J. H. Petersen, directors.

Student Posts

★ ★ DISTINGUISHED STUDENT POSTS, 1960 ★ ★

CITY COLLEGE OF NEW YORK — COLORADO SCHOOL OF MINES — UNIVERSITY OF DETROIT

LEHIGH UNIVERSITY — MICHIGAN COLLEGE OF MINING AND TECHNOLOGY (HOUGHTON)

NORTHEASTERN UNIVERSITY — UNIVERSITY OF TEXAS — UNIVERSITY OF WASHINGTON

(Name of sponsoring local post in parentheses follows each listing.)

*UNIVERSITY OF ALABAMA—(Mobile)

*AUBURN UNIVERSITY—President, Roy L. Heifner; Secretary, Richard A. Mills, 1717 Hill Hedge Dr., Montgomery 6, Ala. (Mobile)

*POLYTECHNIC INSTITUTE OF BROOKLYN—President, Ronald C. Wolfe; Secretary, Kevin M. O'Keeffe, 36 Oliver St., Brooklyn 9, N. Y. (New York City)

C. W. POST COLLEGE—President, John Dunn; Secretary, Minturn Smith, 12 Coolidge Pl., Freeport, L. I., N. Y. (New York City)

*CARNEGIE INSTITUTE OF TECHNOLOGY—President, Raymond E. Gaugler; Secretary, John M. Logue, 420 W. Sample, Ebensburg, Penn. (Pittsburgh)

THE CITADEL—President, Boyd L. Wood; Secretary, James R. Calfee, Box 1328, The Citadel Station, Charleston, S. C. (Charleston)

*CITY COLLEGE OF NEW YORK—President, Jerome Kohn; Secretary, Robert Jeanette, 512 Rosedale Ave., Bronx 72, N. Y. (New York City)

*CLARKSON COLLEGE OF TECHNOLOGY—(Albany-Schenectady)

CLEMSON AGRICULTURAL COLLEGE—President, Carl M. Merchant; Secretary, Tommy R. Fralick, Box 2249, Clemson, S. C.

*COLORADO SCHOOL OF MINES—President, Jerry G. Cronen; Secretary, Fred L. Burrell, 1518 Washington St., Golden, Colo. (Denver)

*UNIVERSITY OF COLORADO — President, Richard A. Koechlein; Secretary, George Koehler, Jr., 5000 West 37th Ave., Denver, Colo. (Denver)

UNIVERSITY OF DETROIT — President, Joseph P. Saline; Secretary, Paul Mueller, 313 Holden Hall, University of Detroit, Detroit, Mich. (Detroit)

*DREXEL INSTITUTE OF TECHNOLOGY—President, Lawrence G. Spielvogel; Secretary, Stephen Plotkin, 3411 Powelton Ave., Philadelphia 4, Penn. (Philadelphia)

*GEORGIA INSTITUTE OF TECHNOLOGY—(Atlanta)

UNIVERSITY OF ILLINOIS (CHICAGO) — (Chicago)

*UNIVERSITY OF ILLINOIS (URBANA) — (Chicago)

INDIANA TECHNICAL COLLEGE—President, Harley Bailey; Secretary, Graydon Brewster, 2922 W. California Rd., Fort Wayne, Ind. (Cleveland)

*IOWA STATE UNIVERSITY — President, Douglas Graham; Secretary, Douglas Klein, 611 Holly St., Brainerd, Minn. (Omaha)

*STATE UNIVERSITY OF IOWA (PONTONNIER)—(Rock Island)

JOHNS HOPKINS UNIVERSITY—(Baltimore)

KANSAS STATE UNIVERSITY — (Greater Kansas City)

UNIVERSITY OF KANSAS—President, James W. Straight; Secretary, R. Dale MacCallum, 2559 Redbud Lane, Lawrence, Kans. (Greater Kansas City)

LEHIGH UNIVERSITY—President, Charles J. Gallagher; Secretary, Arthur Shearer, P. O. Box 271, Lehigh University, Bethlehem, Penn. (Lehigh Valley)

LOUISIANA STATE UNIVERSITY—President, William J. Reynolds; Secretary, William A. Callegari, Student Chapter SAME, Louisiana State University, Baton Rouge, La. (Louisiana)

MANHATTAN COLLEGE—President, Edward M. Gillespie; Secretary, Stephen Hutter, 625 Gramatan Ave., Mount Vernon, N. Y. (New York City)

UNIVERSITY OF MARYLAND—Secretary, Alvin L. Day, 2614 Kirkwood Pl., Hyattsville, Md. (Fort Belvoir)

*MASSACHUSETTS INSTITUTE OF TECHNOLOGY—(Boston)

*MICHIGAN COLLEGE OF MINING AND TECHNOLOGY (HOUGHTON) — President, Richard Currier; Secretary, Glenwood Bradley, R. R. #2, Box 28M, Three Rivers, Mich. (Minneapolis-St. Paul)

*MICHIGAN COLLEGE OF MINING AND TECHNOLOGY (Sault)—President, Albert W. Laaksonen; Secretary, Donald K. Rankin, Jr., 952 Meridian St., Sault Ste. Marie, Mich. (Detroit)

*MISSOURI SCHOOL OF MINES—President, John Childress; Secretary, Earl Neubauer, Jr., Box 110, Rolla, Mo.

UNIVERSITY OF NEBRASKA—(Omaha)

*NEW YORK UNIVERSITY—President, Paul Lerman; Secretary, John Ricci, 411 E. 239th St., Bronx 70, New York, N. Y. (New York City)

*NORTHEASTERN UNIVERSITY (Div. A)—President, Edward B. Wenners, Jr.; Secretary, Thomas W. O'Dea, 65 Silver St., Randolph, Mass. (Boston)

*NORTHEASTERN UNIVERSITY (Div. B)—President, Emile W. J. Troupe; Secretary, John A. Anderson, Jr., 51 Parson Ave., Lynnfield, Mass. (Boston)

*NORWICH UNIVERSITY — President, Kirk W. Shadrick; Secretary, David A. Farr, Norwich University, Northfield, Vt. (Albany-Schenectady)

UNIVERSITY OF NOTRE DAME—President, Thomas M. King; Secretary, Arthur J. Volz, Jr., 2105 Hollywood Pl., South Bend 16, Ind. (Chicago)

OKLAHOMA STATE UNIVERSITY—(Tulsa)

UNIVERSITY OF OKLAHOMA — (Oklahoma City)

*OREGON STATE UNIVERSITY—President, Leonard W. Kearney; Secretary, Paul G. Adams, 527 N. 23rd St., Corvallis, Ore. (Portland)

PENNSYLVANIA MILITARY COLLEGE — (Philadelphia)

PENNSYLVANIA STATE UNIVERSITY — President, James Shoff; Secretary, Marc Apter, 282 Hamilton Hall, University Park, Pa. (Baltimore)

PRATT INSTITUTE—President, Harold Reilly; Secretary, Lawrence Krasnoff, 80-27 233 St., Queens Village 27, N. Y.

*PURDUE UNIVERSITY (FORT WAYNE CENTER)—(Cleveland)

RENSSELAER POLYTECHNIC INSTITUTE—President, Gordon A. Davids; Secretary, David A. Herbert, 21 Huntington, R.P.I., Troy, N. Y. (New York City)

*UNIVERSITY OF RHODE ISLAND—(Boston)

*RICE UNIVERSITY—(Houston)

*ROSE POLYTECHNIC INSTITUTE — President, Joe Andel; Secretary, Andy O. Breece, 1454 S. Center St., Terre Haute, Ind. (Indianapolis)

*SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY—President, Hans J. Giraud; Secretary, Leroy T. Cool, 2324 Cruz Dr., Rapid City, S. D. (Riverdale)

UNIVERSITY OF TENNESSEE — President, William H. Osborne; Secretary, James H. Henry, Box 192, South Stadium Hall, Knoxville, Tenn. (Knoxville)

*UNIVERSITY OF TEXAS—President, Thomas G. Godfrey; Secretary, Louis W. Klingman, 235-B Moore-Hill, Austin 18, Tex. (Austin)

TEXAS A & M COLLEGE—President, Jerry D. Norton; Secretary, Larry A. Porter, P. O. 4305, M.S.C., Texas A & M, College Station, Tex.

TEXAS TECHNOLOGICAL COLLEGE—President, William C. Mills; Secretary, Hugh S. Cameron, Jr., P.O. Box 4236, Lubbock, Tex.

TEXAS WESTERN COLLEGE — President, Harry R. Lamberth; Secretary, Joseph T. Larremore, 3712 Van Buren, El Paso, Tex. (El Paso)

UNIVERSITY OF TOLEDO—(Cleveland)

VIRGINIA POLYTECHNIC INSTITUTE—President, Pierre R. Latour; Secretary, Selwyn L. Flournoy, Jr., Box 3677, Va. Tech Sta., Blacksburg, Va. (Fort Belvoir)

WASHINGTON STATE UNIVERSITY—President, Mark R. Welch; Secretary, Maurice A. Lange, Box 462, College Station, Pullman, Wash. (Walla Walla)

UNIVERSITY OF WASHINGTON—Secretary, Richard A. Linden, 4708 18th St., N. E., Seattle 5, Wash. (Seattle)

UNIVERSITY OF WISCONSIN—(Milwaukee)

UNIVERSITY OF WYOMING—

*Has Engineer ROTC.

POLYTECHNIC INSTITUTE OF BROOKLYN

"The World That Nature Forgot," a Monsanto Chemical Company film, was shown at the October 11 meeting. Of particular interest was the use of colorful animated effects to illustrate the formation of polymers by simple molecules.

Charles Spaulding of the Port of New York Authority was guest speaker at the October 18 meeting. His talk, "A Progress Report on New York International Airport," emphasized the problem of achieving architectural beauty in the new buildings while fulfilling the functional needs of the airport.

Two films, "The Corporal Story" and "Down to Earth," were shown at the October 25 meeting.

Martin S. Kapp, soils engineer for the Port of New York Authority, spoke on "The Settlement Problem at La Guardia Airport" at the November 1 meeting. He explained the problems involved in the marshland base on which the airport was built, and what the New York Port Authority is doing to counteract this potentially dangerous problem.

C. W. POST COLLEGE

The following new officers were elected to fill vacancies at the October 28 meeting: David S. Mott, 1st vice president; Richard McDermott, 2nd vice president; Minturn Smith, secretary; and John Calabrese, board of directors.

THE CITADEL

The following officers for the 1961-1962 school year were elected at the May 15 meeting: Boyd L. Wood, president; James P. Lowsley, vice president; James R. Calfee, secretary; and Thomas M. Snowden, Jr., treasurer.

At the meeting of November 1 the film "Birth of an Era" was shown, describing various aspects of construction on the Savannah River project.

CITY COLLEGE OF NEW YORK

The following officers have been elected for the 1961 fall term: Jerome Kohn, president; Joel Hanover, vice president; Robert Jeanette, secretary; John Barons, membership; Joseph Bergeon, information; Paul Jacobs, operations; and Richard Lander, finance. Capt. Dean Welch is the new faculty adviser, replacing Maj. M. I. Guest.

UNIVERSITY OF DETROIT

On April 29, members toured the ocean-going hopper dredge *Markham.*

The following new officers were elected at the meeting of May 23: Joseph P. Saline, president; William E. Bray, vice president; Ronald A. Gieleghem, recording secretary; Paul Mueller, corresponding secretary; and Charles P. Deland, treasurer.

The post held a joint dinner-dance with the Flintlocks, the University Army rifle team, at the Fort Wayne Officers Club on May 10. Following "coketail" time and dinner, Col. R. C. Pfeil, Detroit District Engineer, spoke on career opportunities open to newly commissioned officers in the Army and Air Force. The following members were presented with awards for their outstanding service to the post: Richard Jursca, William Bray, and Paul Mueller.

At the October 10 meeting, Capt. Thomas Kiernan of the Detroit District Office, Corps of Engineers, spoke on the "Army Corps of Engineers in Civil Works." His talk was followed by a film, "Men, Ships, and Great Lakes," showing how the Corps of Engineers carries out its mission to aid navigation and control floods.

DREXEL INSTITUTE OF TECHNOLOGY

At the meeting of October 5, Lieutenants Williams and Bennett, CEC, USN, spoke on the work of the Civil Engineer Corps and the opportunities for junior officers. A film was shown illustrating the activities of the Corps, and its role in the design of local Capehart housing was described. Four officers of the student post at Pennsylvania Military College attended the meeting.

During the month of October, "The Flaming Sky" and "The Challenge of the Oceans" were presented as part of the post's program of educational and scientific films for the benefit of all interested students.

On October 25, seventeen members of the post met with the Philadelphia Post at the Engineers Club, Philadelphia. Following dinner, Col. Curtis W. Chapman, Chief of Military Engineering Division, Research and Development Office, OCE, spoke on recent research and development activities of the Corps of Engineers.

IOWA STATE UNIVERSITY

Officers elected at the September 21 meeting are: Douglas Graham, president; Neil Olsen, vice president; Douglas Klein, secretary; Larry Deppe, treasurer; and Kenneth Bucklin, public relations chairman.

UNIVERSITY OF KANSAS

At the meeting of October 11 new officers discussed the tentative program for the coming year. Officers are: James W. Straight, president; Stuart A. Schlemmer, vice president; R. Dale MacCallum, secretary; and Michael R. Johnson, treasurer.

President Straight spoke to prospective new members on the purpose and activities of The Society at the meeting on October 17.

LEHIGH UNIVERSITY

At the annual freshman smoker on September 21, Capt. Neil O. McCray, post adviser, outlined the purposes of The Society and the activities of the post. Officers were introduced, and each briefly explained his duties. A movie entitled "West Point" was shown, describing the Military Academy as seen through the eyes of a cadet during his four years there.

Dr. R. T. Gallagher, head of the department of mining engineering at Lehigh University, spoke on underground storage of petroleum products at the meeting of October 5. The capacity of planned and present underground storage sites, including salt caverns, excavated caverns, and oil sands, is approximately 60,000,000 barrels. In addition to military advantages, underground storage is more economical than surface storage.

At the November 9 meeting, Robert A. Schmidt was elected 2nd vice president. A film entitled "The Engineer Mission" was shown.

MANHATTAN COLLEGE

At the meeting of October 18 the film "Alaska Pipeline" was shown, depicting the construction of a pipeline to ship oil from Canada through Alaska.

MICHIGAN COLLEGE OF MINING AND TECHNOLOGY (HOUGHTON)

At the meeting of March 9, a movie was shown on ROTC summer camp activities at Fort Leonard Wood. Lt. Col. Raymond L. Hicks, post adviser, narrated the film.

Professor Trygve Ivesdal, of the electrical engineering department of the college, was guest speaker at the meeting of April 13. His talk, entitled "Microwave Space Platform," dealt with a helicopter-type device which would be used high in space for worldwide communications, radar, and weather detection. The presentation was supplemented by slides and diagrams. The fifth annual post rifle award was presented to Frank Townsend, as the individual high scorer in the 1960 Society ROTC match.

Col. William B. Standberg, Minneapolis-St. Paul District Engineer, spoke on "Military and Civil Functions of the Corps of Engineers" at the meeting of May 13. Newly elected officers are: Richard Currier, president; Ben Balestra, vice president; Knute Bidne, recording secretary; Glenwood Bradley, corresponding secretary; and Robert Parkes, treasurer.

The annual spring banquet was held on May 23. A special feature of the evening was the presentation of a birthday cake, decorated with the Corps of Engineers insignia, to Lt. Col. Raymond L. Hicks, post adviser. Guest speaker was Maj. Gen. George Bush, Commanding General, VI Army

DREXEL INSTITUTE—Pictured at Philadelphia Post meeting are, l to r: George Sardarian; Maj. Robert C. Nelson, adviser; Arthur Schulcz; William A. Tucker; Donald F. Merritt; Aubrey L. Bates; Joseph McGovern; Thomas D. Bartlett; Robert T. Martin; Col. Curtis W. Chapman, speaker; and Col. T. H. Setliffe, Philadelphia Post president.

Corps, who discussed the threat of communism. General Bush also presented the post with the Distinguished Student Post award of The Society.

MICHIGAN COLLEGE OF MINING AND TECHNOLOGY (SAULT)

The following new officers were elected on October 5: Albert W. Laaksonen, president; William C. Palmer, vice president; Donald K. Rankin, secretary; Tony Materna, treasurer; Michael B. TenEyck, assistant treasurer; and Larry Farnquist, student council representative.

At the meeting of October 12 Al Laaksonen spoke to prospective new members on the objectives of The Society and the activities of the post.

NEW YORK UNIVERSITY

On September 21 the post presented an exhibit for the freshman class. The exhibit consisted of a model Bailey Bridge which is used in teaching bridge construction methods.

On October 7 members of the post visited Fort Tilden, a Nike missile base in New York City. Following a tour of the installation, a film was seen depicting the development of the Nike missile, its early tests, and the part it plays in our national defense. The members then proceeded to Fort Jay, on Governor's Island, for luncheon, after which they were conducted on a tour by Maj. W. Hillabrant, post adviser.

NORTHEASTERN UNIVERSITY (Division A)

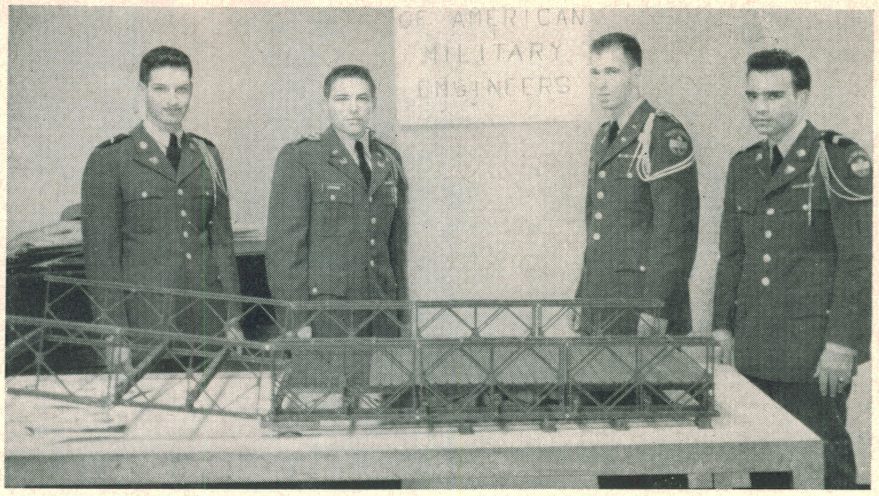
On September 20 the post held its annual freshman smoker. The Corps of Engineers color film "Fighters and Builders" was shown.

Robert Hasset of the Springfield Armory spoke on the new M14 Springfield Rifle at the meeting of September 28. Mr. Hasset was project engineer for the research and development of the M14. Using one of the new rifles to demonstrate, he discussed its development and pointed out its advantages over the weapons which it replaces. A high-speed film showing the bolt action of the M14 was followed by a question and answer period.

Comdr. Gerald L. Short of the Coast and Geodetic Survey described the mission of the Survey and presented a film entitled "Explorer, 1960."

The following new officers were elected on November 2: Edward B. Wenners, Jr., president; Harold A. Davidson, Jr., vice president; Thomas W. O'Dea, secretary; and Sheldon B. Glorit, treasurer.

Norman H. Goldstein, a member of the student post, has been elected Captain of Company H, 11th Regiment, Scabbard and Blade. He is a senior mechanical engineering student in the College of Liberal Arts, is on the Dean's List, and is employed as a technical assistant by the Harvard University Air Cleaning Laboratory.



NEW YORK UNIVERSITY—Post members display model Bailey bridge. L to r: Robert Fox; Paul Lerman, president; Kenneth May, operations officer; and Robert Covino.

OREGON STATE UNIVERSITY

ROTC cadets from the University performed outstandingly at the Summer Camp at Fort Leonard Wood, Missouri, winning the Chief of Engineers award for the second consecutive year as the top school among those taking part in the training program. They also won the Camp Athletic Achievement trophy and were runner-up for the Camp Rifle Marksmanship trophy. Paul E. Gjelde was selected as the "Outstanding Cadet of the Summer Camp." James E. Turner won an outstanding cadet award for his company, as did Kenneth F. Weleber and Leonard W. Kearney, post president.

UNIVERSITY OF NOTRE DAME

The following officers have been elected: Thomas Maxwell King, president; Max Joseph Koeck III, vice president; Arthur Joseph Volz, Jr., secretary; and James Collins, treasurer.

A coat of arms has been adopted by the post which incorporates both the symbols of The Society and of the University in its design.

PRATT INSTITUTE

The following new officers were elected at the meeting of May 10: Harold Reilly, president; Alan Goldfarb, vice president; Lawrence Krasnoff, secretary; Michael Greenberg, treasurer; Charles Bardes, public information officer; and Robert Motylenski, social activities officer.

RENSSELAER POLYTECHNIC INSTITUTE

The following new officers were elected at the October 9 meeting: Gordon A. Davids, president; Richard J. Weader II, vice president; David A. Herbert, secretary-treasurer; and Theodore G. Creedon, membership chairman.

UNIVERSITY OF TENNESSEE

At the meeting of October 4, a film was shown describing the use, advantages, and construction of earth dams.

UNIVERSITY OF TEXAS

At the meeting of April 27, Fulton Lewis III presented the film "Operation Abolition," giving a short introduction and afterwards answering questions from the floor. Approximately 700 guests attended.

Capt. G. D. Young, post adviser, spoke on "Engineer Support in Europe" at the meeting of October 2. Slides illustrating engineering support equipment were shown.

Guest speaker at the meeting of October 16 was Col. Menon W. Whitsitt, operations officer for the Fourth Army, who discussed engineer construction in the Ryukyus and Iwo Jima.

New officers are: Thomas G. Godfrey, president; Jesse J. Sedwick, vice president; Louis W. Klingman, secretary; and Glenn L. Hardin, treasurer.

TEXAS TECHNOLOGICAL COLLEGE

The following new officers were elected at the meeting of October 11: William C. Mills, president; Travis A. Langford, vice president; Hugh S. Cameron, Jr., secretary; Ned K. Burleson, treasurer; and James D. Stacy, master-at-arms. A film entitled "Tale of Two Cities" was shown, describing the atomic attack on Hiroshima and Nagasaki.

Guest speaker at the meeting of October 25 was Col. John D. Bristor, an instructor with the civil engineering department of the college, who discussed the mission and organization of the Corps of Engineers.

UNIVERSITY OF WASHINGTON

James W. Souther, assistant dean of the college of engineering, and H. R. Low, district manager for General Electric, discussed "Placement of Graduate Engineers in Industry" at the October 25 meeting.

BOOK REVIEWS

Appropriate Books for the Engineer's Library

All books reviewed in these columns and any other books may be purchased through THE MILITARY ENGINEER at the publishers' list prices. See also book lists and announcements in advertising section of each issue.

Members of The Society who remit payment with their orders may deduct 10% from the list prices.

But Not in Shame: The Six Months after Pearl Harbor, by *John Toland.* The story of the coming of war to the Pacific — from Pearl Harbor to the Battle of Midway, after which the tide turned. 427 pages. *Random House.* Price, $6.50.

Defeat into Victory, *by Field Marshal the Viscount Slim.* After the debacle of 1942, the British re-entered Burma in 1944 and drove the Japanese out in 1945. This is the story by the soldier who directed the campaign to recapture Burma. 468 pages. *David McKay.* Price, $6.50.

SAVO: The Incredible Naval Debacle off Guadalcanal, by *Richard F. Newcomb.* Early Sunday morning, August 9, 1942, four heavy cruisers were lost in forty minutes at the hands of an inferior Japanese force. How did it happen? Who was responsible? The author attemps to answer, as the official report has never been made public. 278 pages. *Holt, Rinehart and Winston.* Price, $4.95.

The Coming Fury: Volume One of the Centennial History of the Civil War, by *Bruce Catton.* Conceived as a classic tragedy, the "Coming Fury" is presented initially as a series of ever-narrowing circles of choice between war and peace, with fewer and fewer men to choose and finally with but two men with almost no choice at all. It opens with the Democratic Convention in Charleston, April 1860, and closes with the first Battle of Bull Run. 565 pages. *Doubleday.* Price, $7.50.

The United States During the Civil War, by *Auguste Laugel,* edited by Allan Nevins. This 30-year-old Frenchman spent eight months traveling from the Atlantic coast to Missouri and from Maine to Virginia, during which time he kept the diary from which this book was written. Aside from his observations on political and military affairs in America during the Civil War, the author writes that the United States shows that men can found a government on reason, that the people can be religious without a state-supported church, and that woman has been given the place that is her due in civilized society. 338 pages. *University of Indiana Press.* Price, $6.50.

The Regiment That Saved the Capital, by *William J. Roehrenbeck.* The events surrounding the movement of the 7th Regiment of New York to the defense of Washington during the opening months of the Civil War are covered, as well as the return to New York in 1862. The book ends with an Epilogue, 1861-1961. 244 pages. *Thomas Yoseloff.* Price, $5.95.

The Stakes of Power, 1845-1877, by *Roy F. Nichols.* This third of six volumes in "The Making of America" series deals primarily with events leading up to the Civil War, the war itself, and the aftermath. The central theme of this period is seen to be the contest for the control of the political and economic power of the Federal government, a struggle finally won by the Northerners. 246 pages. *Hill and Wang.* Price, $4.50.

Campaigning with Grant, by *Gen. Horace Porter,* edited by Wayne C. Temple. Another volume of the publisher's Civil War Centennial Series. This book recounts the daily acts of General Grant in the field from October 23, 1863, to the end of the Civil War. This is a portrait of the military leader and the man. As aide, chief of staff, and later as White House aide, Porter not only "lived" with Grant during these years, but he was able to write interestingly as well as very readably of his observations. 558 pages. *University of Indiana Press.* Price, $7.50.

Lee: An Abridgement in One Volume, by *Richard Harwell,* of the 4-volume **R. E. Lee** by *Douglas Southall Freeman.* Much of the spirit and enjoyable writing of the classic biography has been retained. 601 pages. *Scribner's.* Price, $10.00.

The Wartime Papers of R. E. Lee, edited by *Clifford Dowdey* and *Louis H. Manarin,* with maps by Samuel H. Bryant. Lee's official correspondence—letters, orders, dispatches, and battle reports—complemented by letters to his family, present an intimate picture of the life of this great American during the Civil War years. 994 pages. *Little, Brown.* Price, $12.50.

Lee's Maverick General: Daniel Harvey Hill, by *Hal Bridges.* One of the brilliant and fiery Confederate commanders, Hill often clashed openly with Lee, Bragg, and Jefferson Davis. A wealth of new information from hitherto unpublished Hill papers is included. 323 pages. *McGraw-Hill.* Price, $7.50.

The Edge of Glory: A Biography of General William S. Rosecrans, by *William M. Lamers.* This Civil War leader, forced to fight a double war, with the Confederates to his front and Grant and Stanton to his rear, won more victories for the North, until Chicamauga, than any other commander. 499 pages. *Harcourt, Brace & World.* Price, $6.95.

The Adventures of Captain Bonneville, U.S.A., in the Rocky Mountains and the Far West, by *Washington Irving,* edited by Edgeley W. Todd. On May 1, 1832, Captain Bonneville led 110 men and 20 wagons westward from Fort Osage, Missouri, for the beaver grounds in the Rockies. Three and one-half years later he and the ragged trappers returned to civilization. This is the story of Bonneville's travels throughout the mountains supervising the trappers, living among the Indians, keeping copious notes and maps. Irving rewrote Bonneville's narrative and published it in 1837. This annotated edition is Volume 34 in the "American Exploration and Travel Series." 424 pages. *University of Oklahoma Press.* Price, $7.95.

The Glorious First of June, by *Oliver Warner.* An account of the great English naval victory over France on June 1, 1794. 184 pages. *Macmillan.* Price, $4.50.

The Franco-Prussian War, by *Michael Howard.* One of the dramatic and decisive wars in Europe (1870-

1871). Thus began the rivalry between France and Germany that led to World Wars I and II. 512 pages. *Macmillan.* Price, $15.00.

The Old China Hands, by *Charles G. Finney.* Nostalgic and humorous reminiscences of an enlisted man's service in the 15th Infantry in Tientsin, China, in the late 1920's. 258 pages. *Doubleday.* Price, $3.95.

Civil War Railroads, by *George B. Abdill.* This handsomely printed and profusely illustrated volume includes biographies of Herman Haupt, Daniel C. McCallum, and Thomas A. Scott, the military railroad chiefs on the Union side, hundreds of fine pictures of railroads and rail equipment operating and destroyed, and brief descriptions of many areas and incidents. 192 pages, 8½ by 10½ inches. *Superior.* Price, $12.50.

Stephen Watts Kearney, Soldier of the West, by *Dwight L. Clarke.* The author shows that neither Frémont nor Senator Thomas H. Benton, Frémont's father-in-law, could prevail against Kearney's distinguished career as a soldier, as an explorer, and as a builder of western Army posts. 448 pages. *University of Oklahoma Press.* Price, $5.95.

Sir Hubert Wilkins: His World of Adventure, by *Lowell Thomas.* A biography of the veteran Arctic explorer. 296 pages. *McGraw-Hill.* Price, $5.95.

Atlantic Crossings Before Columbus, by *Frederick J. Pohl.* A historical detective retraces the voyages of the mariners who crossed the Atlantic before Columbus, including Leif Erikson, Thorfinn Karlsefni, Freydis, and others. The chapters on inscriptions and runestones are particularly interesting. 315 pages. *Norton.* Price, $4.50.

The Scrolls and Christian Origins, by *Matthew Black.* Some scholars state that the new evidence may revolutionize the approach to Christian origins. In any case the importance of the scroll material is acknowledged. 206 pages. *Scribner's.* Price, $3.95.

The Dead Sea Scrolls, An Introduction, by *R. K. Harrison.* Chapters are devoted to the discovery of the scrolls, their contents, dating the manuscripts, the Old Testament and the Qumran sect, and Christianity. 160 pages. *Harper.* Price, $1.25.

Adam's Ancestors, the Evolution of Man and His Culture, by *L. S. B. Leakey.* The relevant materials from paleolithic archaeology and paleoanthropology in Europe, Africa, and Asia, and interpretations and uses of stone and bone tools are included in this well-organized story of the evolution of man and his culture. 235 pages. *Harper.* Price, $1.60.

Seth Eastman, Pictorial Historian of the Indian, by *John Francis McDermott.* This West Point graduate, brevetted a brigadier general on his retirement, was a competent painter as well. Assigned first to Florida and later to Minnesota, he was in contact with the Seminoles, Sioux, and Chippewas. His Indians are men and women, not manikins, moving about their ordinary concerns in the days before the Civil War. Many of the illustrations are closely integrated with the text in this handsome volume. 270 pages. *University of Oklahoma Press.* Price, $10.00.

The St. Lawrence Waterway: A Study in Politics and Diplomacy, by *William R. Willoughby.* A study of the political maneuvers, economic pressures, and diplomatic moves that enabled the project to be initiated. 381 pages. *University of Wisconsin Press.* Price, $6.00.

Ground Support Systems for Missiles and Space Vehicles, edited by *Kenneth Brown* and *Peter Weiser.* Systems required to support missiles and vehicles are described in detail. Subsystems, data systems, facilities, propellant handling, maintenance, and logistics are among the items and factors also considered. 490 pages. *McGraw-Hill.* Price, $15.00.

Handbook of Astronautical Engineering, *H. H. Koelle,* editor-in-chief. Some 180 specialists assisted in this summary of the present state of space flight engineering. It includes sections on fundamentals of astronautical engineering, astrodynamics, astrionics, propulsion, space vehicles, and space flight operations. 1,869 pages. *McGraw-Hill.* Price, $27.50.

The Mechanics of Inertial Position and Heading Indication, by *Winston Markey* and *John Hovorka.* The kinematics of points and co-ordinate systems translating and rotating in space, the mechanization of differential equations by electromechanical techniques, and the study of information flow in closed-loop systems are covered. 94 pages. *Wiley.* Price, $3.95.

Numerical Methods in Engineering, by *Mario G. Salvadori* and *Melvin L. Baron.* The second edition of a text on methods for the numerical solution of problems in engineering and applied science. 302 pages. *Prentice-Hall.* Price, $10.65.

Semiconductor Reliability, edited by *John E. Schwop* and *Harold J. Sullivan.* The results of large-scale test programs as to the quality of semiconductors are presented. 309 pages. *Reinhold.* Price, $8.50.

Elements of Strength of Materials, by *Stephen Timoshenko* and *D. H. Young.* This fourth edition of a classic text that contains 400 problems is a complete revision. 377 pages. *Van Nostrand.* Price, $6.75.

Statistical Analysis and Optimization of Systems, by *E. L. Peterson.* The theory and methods underlying the analysis, synthesis, and optimization of systems in which statistical uncertainty is involved in the process dynamics. 190 pages. *Wiley.* Price, $9.75.

Industrial Instrumentation, by *Forrest C. Tyson, Jr.* Intended especially for the technician engaged in installing, maintaining, and altering industrial instruments. 365 pages. *Prentice-Hall.* Price, $9.00.

Prestressed Concrete Cylindrical Tanks, by *L. R. Creasy.* Methods that reduce the time for design calculations, construction procedures to insure liquid tightness, and selected examples of tanks previously constructed are featured in this British text. 216 pages. *Wiley.* Price, $6.75.

Thermostatics and Thermodynamics, by *Myron Tribus.* A generous use is made of illustrative and review problems in this volume of the publisher's series in basic engineering. 649 pages. *Van Nostrand.* Price, $10.95.

Simplified Mechanics and Strength of Materials, by *Harry Parker.* In this second edition, basic information in the field of mechanics and strength of materials is included. 285 pages. *Wiley.* Price, $6.75.

Introduction to Feedback Systems, by *L. Dale Harris.* The basic principles of linear systems are presented. 363 pages. *Wiley.* Price, $10.50.

Analysis of Nonlinear Control Systems, by *Dunstan Graham* and *Duane McRuer.* Primarily for the practicing control engineer. 482 pages. *Wiley.* Price, $9.75.

Shore Protection Planning and Design, Technical Report No. 4, Beach Erosion Board, Office of the Chief of Engineers, U. S. Army. A comprehensive compendium of available knowledge of coastal engineering problems, with a summary of applicable methods, techniques, and data for engineers. About 430 pages. *Superintendent of Documents.* Price, $3.00.

Experimental Methods in Combustion Research, edited by *J. Surugue.* A loose-leaf manual in English and

French, published for the Advisory Group for Aeronautical Research and Development (AGARD), North Atlantic Treaty Organization. It includes timely and comprehensive data on the methods used and recommended, and is intended to make them accessible to researchers and engineers. About 300 pages. *Pergamon.* Price, $15.00.

Unit Operations of Sanitary Engineering, by *Linvil G. Rich.* The physical processes of major importance in the design of sanitary engineering treatment facilities are described, with stress placed on the rational rather than the empirical approach to design problems. 308 pages. *Wiley.* Price, $10.75.

Engineering Descriptive Geometry, by *Charles Elmer Rowe* and *James Dorr McFarland* (third edition). For students, draftsmen, architects, and engineers. 375 pages. *Van Nostrand.* Price, $6.00.

Industrial Electronics Made Easy, by *Tom Jaski.* An analysis of industrial generators, techniques for transducers, servos, and basic test techniques. 288 pages. *Gernsback.* Price, $5.95.

Dynamic Optimization and Control: A Variational Approach, by *Walerian Kipiniak.* The computation of solutions for such practical problems as vehicle stabilization, trajectory control, chemical process control, and inventory control are demonstrated. 233 pages. *Wiley.* Price, $4.95.

Shock and Vibration Handbook Library, edited by *Cyril M. Harris* and *Charles E. Crede.* Major phases of shock and vibration technology are covered in the three volumes, in which information needed for the solution of problems in this field is furnished. 2,028 pages. *McGraw-Hill.* Price, $47.50 (set of three volumes).

Selected Values of Chemical Thermodynamic Properties. Part II. References, by *Frederick D. Rossini, Donald D. Wagman, William H. Evans, Samuel Levine,* and *Irving Jaffee.* National Bureau of Standards Circular 500—Part I, Tables; and Part II, References; reprinted July 20, 1961. No attempt has been made to include new data or to revise values. 1,268 pages (the two volumes). *Superintendent of Documents.* Price, $2.25 (paper).

Geodesy in the Space Age, edited by *Simo H. Laurila* and *W. A. Heiskanen.* In this record of the symposium at Ohio State University (Publication No. 15), February 6-8, 1961, under sponsorship of the Institute of Geodesy, Photogrammetry and Cartography, the Department of Geodetic Science, and the National Science Foundation, some 36 papers are presented, together with discussions. 222 pages. Mimeographed. *Ohio State University.* Price, $2.50.

Problems in Applied Descriptive Geometry, by *Matthew McNeary.* Designed to be used with the publisher's text, *Applied Descriptive Geometry,* by Warner and McNeary. About 70 pages, 8½ by 11 inches. *McGraw-Hill.* Price, $3.95.

Geology of the Atlantic and Gulf Coastal Province of North America, by *Grover E. Murray.* The first comprehensive synopsis of geologic data about the coastal region between Newfoundland and Spanish Honduras, this book presents a three-dimensional picture of the continental shelf, coastal plain, and certain plateau and mountain elements of the Mesozoic and Cenozoic coast. A large landform map, handsome endpapers, a map of the entire area, a list of equivalents, and 573 illustrations complete a comprehensive volume. 692 pages, 8⅜ by 11 inches. *Harper.* Price, $24.00.

Hammond's Ambassador World Atlas: 60th Anniversary Edition. The 1960 census with its changes in population, in national areas, and in place names, and facts about the planets, satellites, and space are included in this handsome, authoritative, and comprehensive atlas, as well as a large section about Africa and its new nations, and many full-color maps. 500 pages. *Hammond.* Price, $15.00.

Arco 1962 Income Tax Guide, by *S. Jay Lasser.* For the 1961 and 1962 income tax returns—featuring sample returns, tips on tax savings, and how to keep tax records. 128 pages. 8½ by 11 inches. *Arco.* Price, $1.00 (paper).

Safety Rules for Installation and Maintenance of Electric Supply and Communication Lines. This is Part 2, Definitions and Grounding Rules of the Sixth Edition of the National Electrical Safety Code (NBS Handbook No. 81). 197 pages. *Superintendent of Documents.* Price, $1.75.

Annual Report of the Smithsonian Institution, Showing Operations, Expenditures, and Condition of the Institution for the Year Ended June 30, 1960. 605 pages. *Superintendent of Documents.* Price, $4.50.

Concerning Some Legal Responsibilities in the Practice of Architecture and Engineering and Some Recent Changes in the Contract Documents, by *John R. Clark.* An edited version of the report, "Professional Liability and Responsibility," of the AIA-EJC Liaison Committee. 24 pages, 8½ by 11 inches. *Engineers Joint Council.* Price, $1.00 (paper).

Report Writers' Handbook, by *Charles E. Van Hagan.* For technical as well as administrative report writing, this is a guide to current procedures. All phases of report preparation are discussed, with special attention being given to illustrations and tables. 276 pages. *Prentice-Hall.* Price, $6.75.

International Maritime Dictionary, by *René de Kerchove.* This up-to-date second edition of a standard handbook now contains many new terms. French and German equivalents are included for definitions in this comprehensive and authoritative text. 1,018 pages. *Van Nostrand.* Price, $20.00.

Handbook for Technical Writers, by *R. C. Tracy* and *H. L. Jennings.* 134 pages. *Privately printed.* Price, $3.50.

The Scientific Papers of J. Willard Gibbs: Volume One, **Thermodynamics,** 434 pages, price, $2.00; Volume Two, **Dynamics, Vector Analysis and Multiple Algebra, Electromagnetic Theory of Light, and Miscellaneous Papers,** 284 pages, price, $2.00; **Elementary Principles in Statistical Mechanics,** 207 pages, price, $1.45; and **Vector Analysis,** 436 pages, price, $2.00; **Oddities and Curiosities of Words and Literature,** edited by *Martin Gardner.* 375 pages. Price, $1.50. **Phrase and Word Origins: A Study of Familiar Expressions,** by *Alfred H. Holt.* 254 pages. Price, $1.35. *Dover* (paper) prints and reprints.

Lovejoy's College Guide, by *Clarence E. Lovejoy.* A reference book to 2,356 American colleges and universities, this guide tells how to choose a college, be admitted, get scholarships and other aid, estimate expenses, and work one's way. Helpful for the college-bound student and his parents. 335 pages. *Simon and Shuster.* Price, $3.50.

The Old Farmer's Almanac, 1962. With its wealth of almanac data, weather forecasts, anecdotes, and other miscellany, the new edition features "The Rime of the Ancient Mariner," illustrated by old cuts. 112 pages. *Yankee.* Price, 35 cents (paper).

Teen-Age Treasury of Our Science World, edited by *Seon Manley* and *Gogo Lewis.* Contributions from Twain, Franklin, Edison, Newton, Thoreau, and more than forty others make up a fine book for the young and the old. 335 pages. *Funk & Wagnalls.* Price, $4.95.

The Jungle Books, by *Rudyard Kipling.* A new paperback edition of this children's classic. 334 pages. *Signet.* Price, 50 cents.

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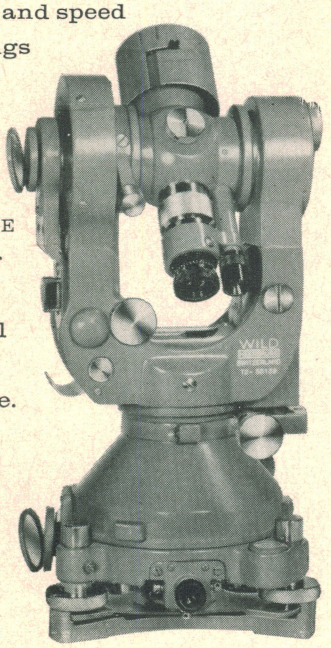

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AUTHORS

Colonel David D. Barrett, who was retired from active duty in 1952, served in the Far East for over 25 of his 34 years in the Army. At the time of his retirement he was stationed in Formosa as Army Attaché, United States Embassy. He was first assigned to China in 1924 as an Attaché for Language Study in the United States Legation, Peking. He has traveled extensively throughout China and the Far East. Colonel Barrett was employed in 1953-1954 in a civilian status as special assistant to the Assistant Chief of Staff, J-2, Far East Command, in Tokyo.

Edwin C. Bearss is regional research historian for Region 1 of the National Park Service. He was the organizer of the Civil War Round Table of Mississippi. He has made an intensive study of the Vicksburg campaign and of several others of the Civil War. During World War II he was with a Marine raider battalion in the invasions of Guadalcanal and New Britain. Mr. Bearss attended Georgetown University and received his master's degree at Indiana University.

Lieutenant Colonel Walter C. Carey is chief of the Design Branch, Engineering Division, Army Engineer District, New Orleans. After serving with the 14th Engineers in World War I, he joined the New Orleans District as Junior Engineer in 1920. He has been with the District since then, except during 1930-1932, when he served as specialist in river stabilization, Mississippi River Commission; 1950-1953, when he was with the Southwestern Division, Tulsa, as liaison representative for the Lower Mississippi Valley Division Engineer; and during World War II when he was engineer and construction officer, Eastern Base Section, ETOUSA. Colonel Carey was awarded the Toulmin Medal in 1944 for his paper in THE MILITARY ENGINEER on "Soil Engineering Practices for Military Engineering."

Kenneth J. Deacon of the Engineer Historical Division, Office, Chief of Engineers, received a Ph.D. degree from New York University, which he attended on a fellowship. He served as a sergeant through five campaigns in North Africa and Europe. After World War II, he taught history and political science at Butler and Illinois Wesleyan Universities. At present he is writing *Combat Engineer Operations* in the *Engineers of the Southwest Pacific* series. He is a frequent contributor to the Combat Engineers series in THE MILITARY ENGINEER.

Jack De Ment is president of De Ment Laboratories in Portland, Oregon, and is research consultant in biophysics and pharmacology at the University Medical Center (Dental School) in Portland. He specializes in luminescence and extra-visual radiation, as well as in biophysics. In 1946 he was scientific consultant to the Secretary of War, assigned to the United Nations Group, in connection with Operation *Crossroads* on Bikini.

Major Ernest J. Denz is assigned to Headquarters EUSA in Korea, having recently completed a tour of duty as District Engineer of the Lake Survey of the Corps of Engineers. Previous assignments have included service with engineer units in the Philippines; a four-year tour of duty with the Armed Forces Special Weapons Project, Sandia Base, New Mexico; and a three-year tour with the 25th Infantry in Hawaii. He is a graduate of the U. S. Military Academy and the Command and General Staff College, and has also been a postgraduate student at the Massachusetts Institute of Technology.

Major General Robert J. Fleming, Jr., Division Engineer, Southwestern Division, was formerly New England Division Engineer. Prior to his present assignment he commanded the Theater Army Support Command, Europe. He also has served as Philadelphia District Engineer; Engineer, Army Field Forces; Assistant Chief of Engineers for Military Operations; and chief of the Organization and Training Division, Office, Chief of Engineers. During World War II he was successively Chief of Staff, Hawaiian Department Service Force, and Deputy Chief of Staff, Central Pacific Area; commander, 1140th Engineer Combat Group; and XXII Corps Engineer. He is a graduate of the U. S. Military Academy and holds the degree of B.S. in mechanical engineering from the Massachusetts Institute of Technology.

Lieutenant Colonel George L. Hahn is the Air Force area medical liaison officer assigned to the Aerospace Medical Center at San Antonio, Texas. He joined the Regular Army Medical Department in 1940, and served through all grades from private to his present rank. Assignments have included deputy chief, facilities division, Headquarters, Air Force Surgeon General's Office; chief of plans and programs division, Headquarters Air Force in Europe; senior Air Force liaison instructor, Army Medical Field Service School; and commander, Aeromedical Evacuation Squadron and Research Projects, School of Aviation Medicine.

Anthony V. Iarrobino is a civil engineer with the Army Corps of Engineers, North Atlantic Division. He served with the Navy in World War II. He is a graduate of Dartmouth College and holds an M.S. degree in soil mechanics from the Harvard Graduate School of Engineering.

Colonel Adolf Kroeber is the Air Force regional civil engineer for the Southwest, based at Dallas, Texas. He entered active commissioned service in the United States Army in 1940. During World War II he served as air base construction liaison officer for the 20th Air Force on Tinian and Guam. Since the war his assignments have included duty with Director of Installations, Headquarters USAF; as assistant chief of staff, Installations, Headquarters 12th Air Force in Germany; chief, construction division and assistant deputy chief of staff, Installations, Headquarters Air Force in Europe; and Air Force Regional Civil Engineer, Ohio River.

George H. Kurttila is a civil engineer on the staff of the Board of Engineers for Rivers and Harbors, having been employed by the Corps of Engineers since 1934. He has served in the district office in Duluth, with the Lake Survey, and in the Seattle Engineer District. He has held his present assignment since 1957. He is a graduate of Michigan College of Mining and Technology, with a B.S. degree in civil engineering, and is a registered professional engineer in the State of Washington.

Colonel William W. Lewis heads the Engineer and Facilities Branch of the G-4 Division, Headquarters, Marine Corps. He has served as commander of the 2d Engineer Battalion, 2d Marine Division; division engineer officer of the 1st Marine Division in Korea; and as staff engineer officer of Headquarters, Fleet Marine Force, Atlantic, and of Headquarters, Fleet Marine Force, Pacific. He is a graduate of the Army Engineer School, Senior Engineer course, the Industrial College of the Armed Forces, and the Virginia Military Institute. He holds a B.S. degree in civil engineering and is a registered civil engineer in the District of Columbia.

Captain Daniel L. Lycan, now assigned to MAAG, Vietnam, was recently special assistant to the director of the Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. His assignment included working on nuclear weapons effects research and development projects. As a distinguished military graduate of the Massachusetts Institute of Technology, he received an appointment in the Regular Army, Corps of Engineers, in 1952. He has served with the 407th Engineer Battalion (Combat); with the 94th Engineer Battalion (Construction) in Europe; and on the faculty of the Army Engineer School. He is a graduate of that school, and holds an M.S. degree in civil engineering and a Ph.D. degree from the University of Illinois. He is a registered professional engineer in the State of Mississippi.

Brigadier General W. R. Shuler is Division Engineer, Missouri River Division. Prior to this assignment he served a two-year tour as Mediterranean Division Engineer. During World War II he was Task Force engineer in the Aleutian campaign, commanded the 1115th Engineer Combat Group, XIX Corps, First Army, in the European Theater, and in 1946 served with the Manhattan District project in Washington, D. C., under which the first nuclear bomb was developed. He later served four years with the Deputy Chief of Staff for Logistics. He is a graduate of the U.S. Military Academy and holds a degree in electrical engineering from the California Institute of Technology, and a master's degree in civil engineering from the University of California.

George K. Swinzow is on the research staff of the Cold Regions Research and Engineering Laboratory of the Army Corps of Engineers. He is engaged in basic and applied research connected with perennially frozen ground. He was born and received his fundamental education in Russia, where he studied geology and engineering. He was engaged in arctic research in Russia and worked in mining engineering in Germany. He immigrated to the United States in 1952 and worked as a laborer and machinist until he became sufficiently acquainted with the language to continue his education. He became naturalized in 1957. He received a Ph.D. degree from the Boston University and taught there at the graduate level before joining CRREL in 1958.

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When you assign a product-development project to LeTourneau-Westinghouse, it gets *expert* attention. Working for you are more than 500 scientifically trained men of diversified talents and extensive experience on military assignments. Also: more than two million square feet of plant area, specially tooled to produce wheeled transport, lifting, earthmoving and grading equipment, off-highway haulers. And, with world-wide distribution, you're assured of service and parts facilities anywhere.

In addition to major product development, LW is available on sub-contract basis for the manufacture of component parts — such as brakes, frames, control systems, power transmissions, etc. Expert workmanship in metal fabricating and scientific methods of quality control assure you of a product or component that meets your exact specifications.

When these services are required, please write or call collect our Government Sales offices listed below.

20-ton rough terrain crane designed for U.S. Army Corps of Engineers is shown equipped with a 30-ft strut boom. Also available: six 10-ft insert sections, and a 15-ft jib boom. Machine can be used for clamshell or dragline work and also as a light bulldozer. Crane is built by American Hoist & Derrick Company; carrier, by LeTourneau-Westinghouse Company.

2401-ML-1

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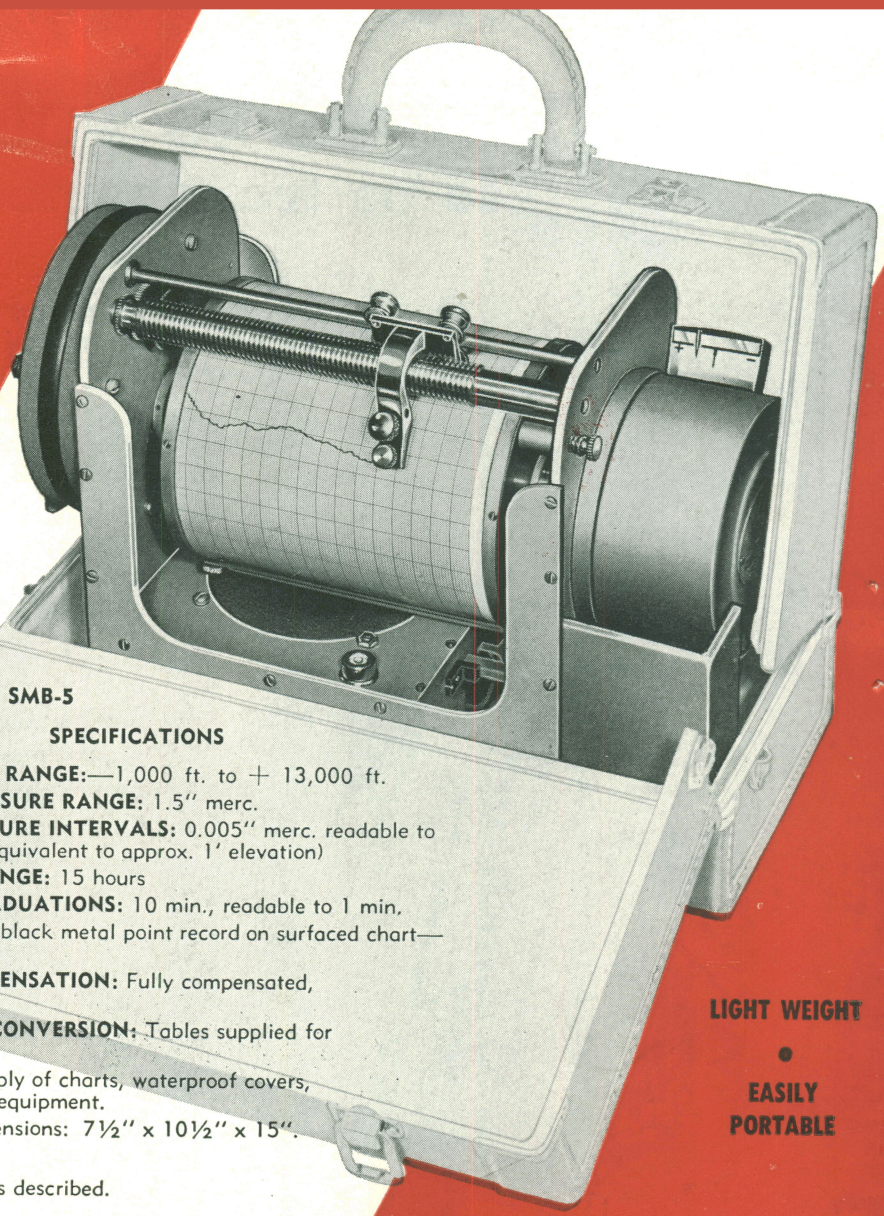

MODEL SMB-5

SPECIFICATIONS

ALTITUDE RANGE:—1,000 ft. to + 13,000 ft.
CHART PRESSURE RANGE: 1.5" merc.
CHART PRESSURE INTERVALS: 0.005" merc. readable to 0.001" merc. (equivalent to approx. 1' elevation)
CHART TIME RANGE: 15 hours
CHART TIME GRADUATIONS: 10 min., readable to 1 min.
CHART: Permanent black metal point record on surfaced chart—no ink used.
TEMPERATURE COMPENSATION: Fully compensated, no correction required.
PRESSURE—ALTITUDE CONVERSION: Tables supplied for immediate conversion.
ACCESSORIES: Generous supply of charts, waterproof covers, and all necessary operational equipment.
CARRYING CASE: Outside dimensions: 7½" x 10½" x 15".
WEIGHT COMPLETE: 20 lbs.
PRICE IN U.S.A.: $890 complete as described.

LIGHT WEIGHT
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6,000 feet (—1,000' to 5,000') in intervals of 1'.	10,000 feet (0' to 10,000') in intervals of 2'.	15,000 feet (0' to 15,000') in intervals of 5'.	2600 meters (—100 meters to + 2500 meters) in intervals of one-half meter.	5,000 meters (0 to 5,000 meters) in intervals of 1 meter.

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